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ASSESSMENT OF KNOWLEDGE AND AWARENESS OF RADIOLOGICAL STAFF REGARDING COMPUTED TOMOGRAPHY EXPOSURE PARAMETERS IN DELHI NCR HOSPITAL AND DIAGNOSTIC CENTER.

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DISSERTATION

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Submitted in partial fulfillment of the

Requirements for the award of the degree

of

MASTER OF SCIENCE

In

MEDICAL IMAGING TECHNOLOGY

By

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All the statistical calculations of this study are authentic and correct to the best of my knowledge.

Wish her all the success in his life.

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GLOSSARY OF ABBREVATION

Sr No.	Abbreviation	Full form
1.	American College of Radiology	ACR
2.	As LowAs Reasonably achievable	ALARA
3.	Automatic Tube Current Modulation	ATCM
4.	Clinical Specialist Radiographers	CSR
5.	Computed Tomography	CT
6.	Diagnostic Reference Levels	DRL
7.	Dimensions	D
8.	Dose Length Product	DLP
9.	Et alibi and co worker	Et.al
10.	Figure	Fig
11.	Kilovoltage Peak	kVp
12.	Milliampere Second	mAs
13.	Minutes	Mins
14.	Multi Detector Computed Tomography	MDCT
15.	Multiple Choice Question	MCQ
16.	Percentage	%
17.	Second	Sec
18.	Standard Deviation	SD
19.	Volume weighted computed tomography dose index	$CTDI_{vol}$

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ABSTRACT

Aim: ASSESSMENT OF KNOWLEDGE AND AWARENESS OF RADIOLOGICAL STAFF REGARDING COMPUTED TOMOGRAPHY EXPOSURE PARAMETERS IN DELHI NCR HOSPITAL AND DIAGNOSTIC CENTER.

Methodology: The cross - sectional study was conducted among a population of 123 CT Technologist and 123 Radiographers. The participants for the study were taken from selected hospitals and diagnostic centers Delhi-NCR. A self-structured closed ended questionnaire was prepared and approved by the head of the department. Data was recorded and statistical analysis was done using Microsoft excel and S- Test software.

Result: The participants for CT Technologist consist 123 samples out of which 45 (36.6%) are female CT Technologist and 78 (63.4%) were male CT Technologist and 61 (49.6 %) were female Radiographer and 62 (50.4 %) were male Radiographer.

On asking about knowledge related to CT exposure parameters, both participants had different levels of knowledge. The responses shows that CT Technologist had answered overall 83.74 % correct answer and 16.26 % of incorrect answer, and the responses from radiographer shows that they had answered 77.5 % correctly while only 22.4 % had answered incorrectly. This result indicates that CT Technologist have good knowledge about CT exposure parameters than Radiographers.

Conclusion: More level of knowledge and awareness should be created among CT Technologist and radiographers However, some workshops and seminars for both CT Technologist and radiographers regarding CT exposure parameters on the CT department, so that they can practice the CT parameters more accurately and upgrade and update their knowledge, there should a specialized incharge in the department who should check the uses of parameters into the department on regular basis.

Keywords: Radiographer, CT Technologist, kVp, mAs, ATCM, Noise, Pitch, Slice Thickness, Radiology Department.

CHAPTER – 1

INTRODUCTION

INTRODUCTION

1.1 OVERVIEW OF CT SCAN

1.1.1 Computed Tomography (CT) – Godfrey Hounsfield, British Engineer of EMI laboratories introduced first commercial CT scanner [1]. CT scan was established in medical diagnosis in the 1970s in the United Kingdom. Initially, it was limited to head imaging, but as technologies advanced, imaging facilities for the whole body became accessible. The CT scan creates cross-sectional pictures of the body using x-rays. The primary benefit is its efficiency, as new generation CT scanners can image huge body parts in a matter of seconds [2].

CT has made an enormous impact in modern medicine. Due to the high accuracy, speed, non-invasiveness, and higher image resolution than conventional digital radiographic imaging, allowing physicians and radiologists to visualize the internal structure of the body, thus technique is gaining attraction in rapid diagnosing and monitoring disease processes [3].

The basic introduction of CT is that we can get the detailed images of body parts in multiple slices with in a second or minutes usually in 2D image and even in 3D [4]. CT machine is basically a large, rounded shaped machine with a small tunnel in the center while the patient will lie on a narrow table that slides in and out of the tunnel as illustrated in fig. 1

Fig1: CT Scan Machine

1.1.2 Components of CT scan machine:

The basic components of CT scan like x-ray tube unit, detectors, patient couch and the image reconstruction unit are shown in fig 2.

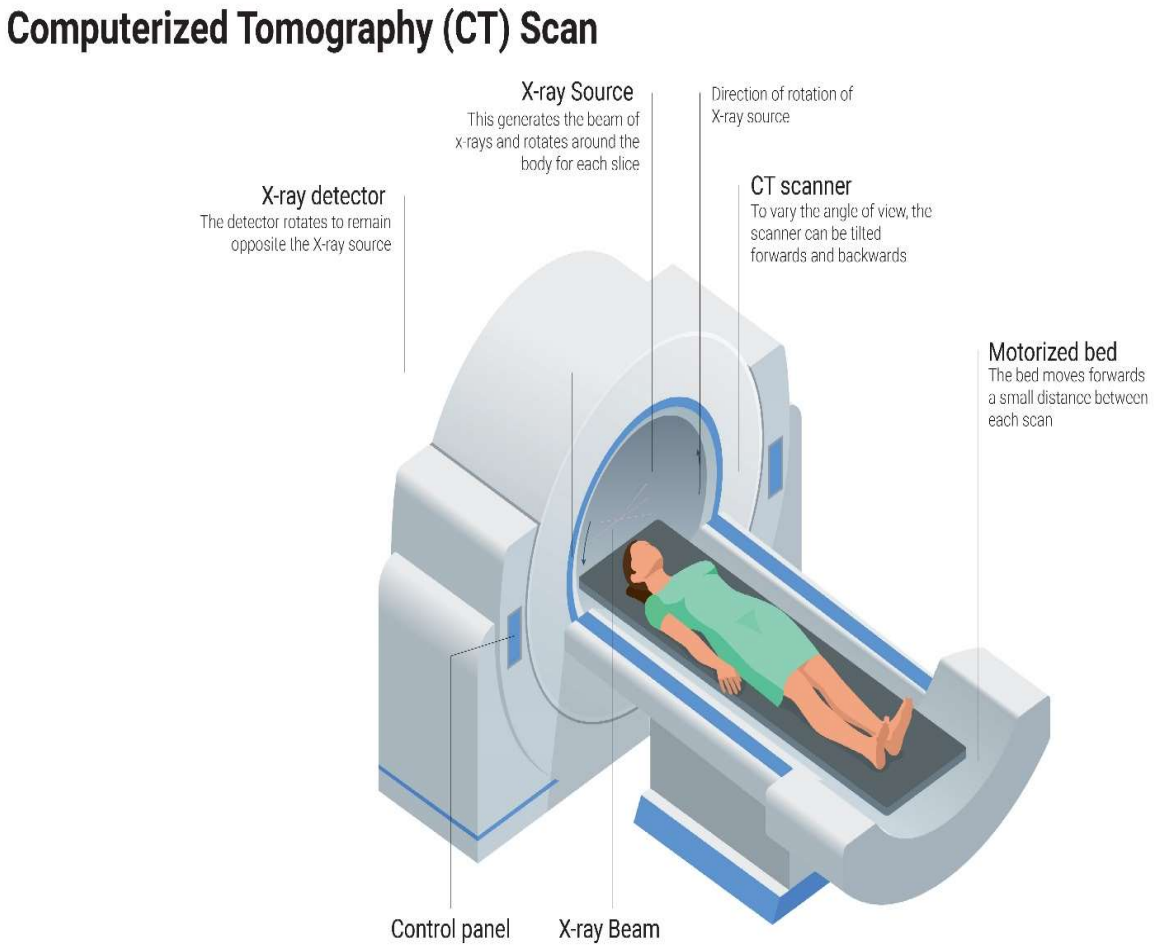

Computerized Tomography (CT) Scan
X-ray Source
This generates the beam of x-rays and rotates around the body for each slice
Direction of rotation of X-ray source
X-ray detector
The detector rotates to remain opposite the X-ray source
CT scanner
To vary the angle of view, the scanner can be tilted forwards and backwards
Motorized bed
The bed moves forwards a small distance between each scan
Control panel
X-ray Beam

Fig2: Labelled diagram of basic components of CT scan machine

As shown in fig. 2 the following components are described below:

- X-ray tube lies in the gantry of the machine, an x-ray tube is made up of glass or from metal ceramic and it is vacuum tube and it converts electrical input power into x-rays which is targeted towards the patients to obtain the images.

- Detectors is placed on the opposite side of the x-ray source. The main purpose is to detect the x-rays that are passing through the patient, they are attenuated differently by various tissue according to various tissue density. There are two types of detectors that are used, Scintillation detectors and gas filled detectors.
- Patient couch is the place where the patient lies during the CT scan examination, which moves in and out of the gantry during the scan and even can be operated manually.
- Tomographic images obtained from the x-ray projection at various angles surrounding the patient are produced by a method of mathematics known as image reconstruction in computed tomography (CT).

- Operating console is the area from where the radiographers control the machine and other variables such as the thickness of the imaged slice, mechanical movement of the patient couch and other factors [5].

Quality of image and radiation dose have great bonding between them. Good image quality can be achieved at low dose. The parameters like mAs, Kvp, pitch, image noise, ATCM (Automatic Tube Control Modulation) and slice thickness have straight effect on quality of image and dose of patient. Raising the mAs and Kvp and lowering the pitch and slice thickness there will be rise in x-ray quantity and the quality of image will also improve, but the dose of patient will also be high [6]. Radiation exposure at high doses increases the risk of cancer over a lifetime, and this risk is estimated to be significantly higher in children than in adults due to their increased sensitivity to radiation [7]. Radiographers or CT technician must be aware about the various CT parameters so that they can adjust the parameters according to the patient size and shape. While doing the CT examination radiographers or CT technician should follow as low as reasonably achievable (ALARA) principal, which is recommended for reducing the dose for both patients as well as radiographers [8].

To make such an optimization, accurate knowledge of all CT parameter is critical. Furthermore, as CT technology will continue to change at a rapid pace, technologists must always reevaluate and update their knowledge [3].

Recent advances in CT technology have proven significant where radiographers can blend different parameters before or during the scan accordingly to patient size and shape, which will definitely reduce the radiation dose and would provide enhanced quality images for various pathology and diagnosis of diseases [8].

CT has now evolved from single detector CT to multiple detector CT where multiple number of detectors is placed in array which produced faster imaging of the patient with good image quality and eventually as the scan is done in less time the dose of the patient will also reduce. Multi Detector Computed Tomography (MDCT) is very useful in diagnosing more complicated pathology and fine fractures, it gives more correct and faster imaging [9].

1.2 CT PROTOCOLS

According to ACR (American College of Radiology) statement, the radiologist, CT technologist and physicist should converge on the design of all new and modified protocols to attain the acceptable image resolution but with the lowest possible dose [10].

1.2.1 Peak Kilovoltage (kVp): Changes in kV will therefore also result affect the amount of contrast in the resultant image [11]. Along with the mAs (tube current and exposure time product), kVp (tube voltage) is one of the primary settings that can be adjusted on CT machines to control the image quality and patient dose [11]. The peak kilovoltage controls the overall energy of the X-ray photons, so any change will influence the number of photons penetrating the body tissue, with a resultant effect on both radiation dose and image noise [12]. In CT scan, kVp lies between 80-120 [13]. While patient dose reduction, increasing noise and no impact on vascular enhancement have stated by a large number of technologists in similar studies [14]. The amount of radiation produced increases as the square of the kilovoltage. 15% increases in kV are equivalent to doubling the mAs [15].

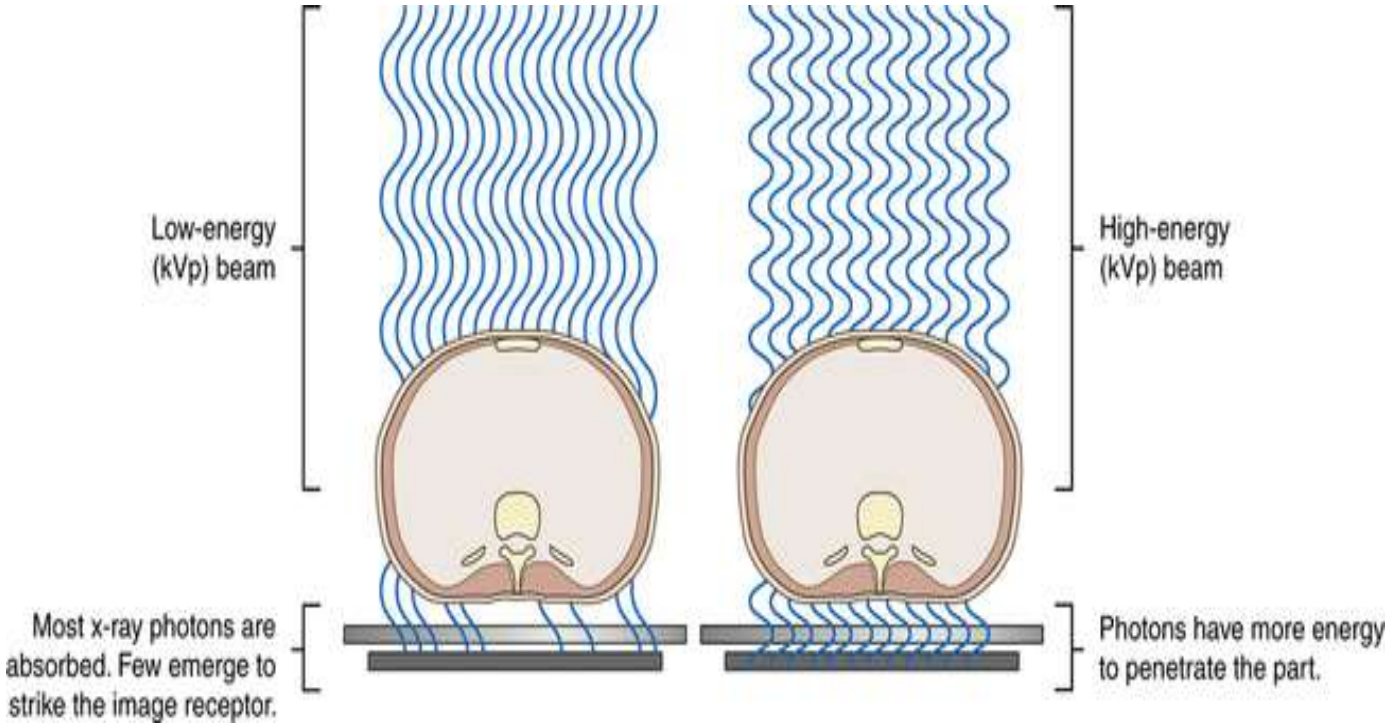


Fig 3: kVp and Radiation Exposure. Increasing the kVp increases the penetrating power of the radiation and increases the exposure to the image receptor.

1.2.2 Tube current (mA): The no. of x-rays produced depends on no. of electrons that strike the targets of the tube and no. of electrons directly depends on tube current used [15]. mA primarily effects the quantity of radiation as the quantity of radiation doubles, the mA also doubles and hence increase patient dose [16].

mAs (milli-ampere seconds) is product of mA and time. High kVp require a subsequent reduction in the mAs and hence kVp technique results in a reduced dose to the patient [16]. Noise reduces the low contrast detectability within CT images and may hence obscure important anatomical findings [8].

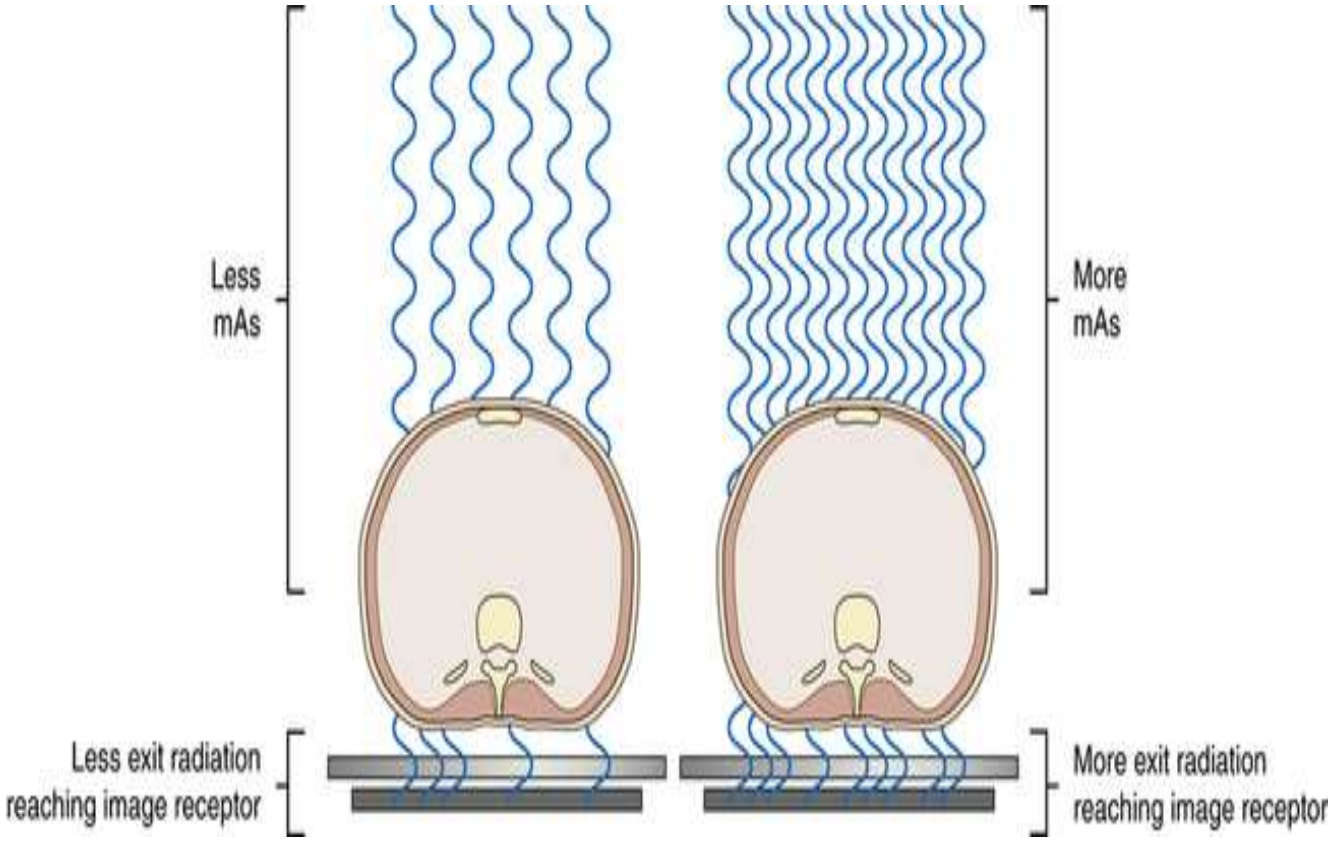


Fig 4: mAs and Radiation Exposure. As the quantity of x-rays is increased (mAs), the exposure to the image receptor proportionally increases.

1.2.3 Slice Thickness: Maximum slice thickness enhances CT image detail and structure despite more noise. Based on the results, a slice thickness of 1.25mm was identified as the optimal choice for reducing image noise and achieving better and more accurate detection using the single-source computed tomography protocol. Increasing the slice thickness, decreases the patient dose. Increasing the number of slices will increase the scan time [17].

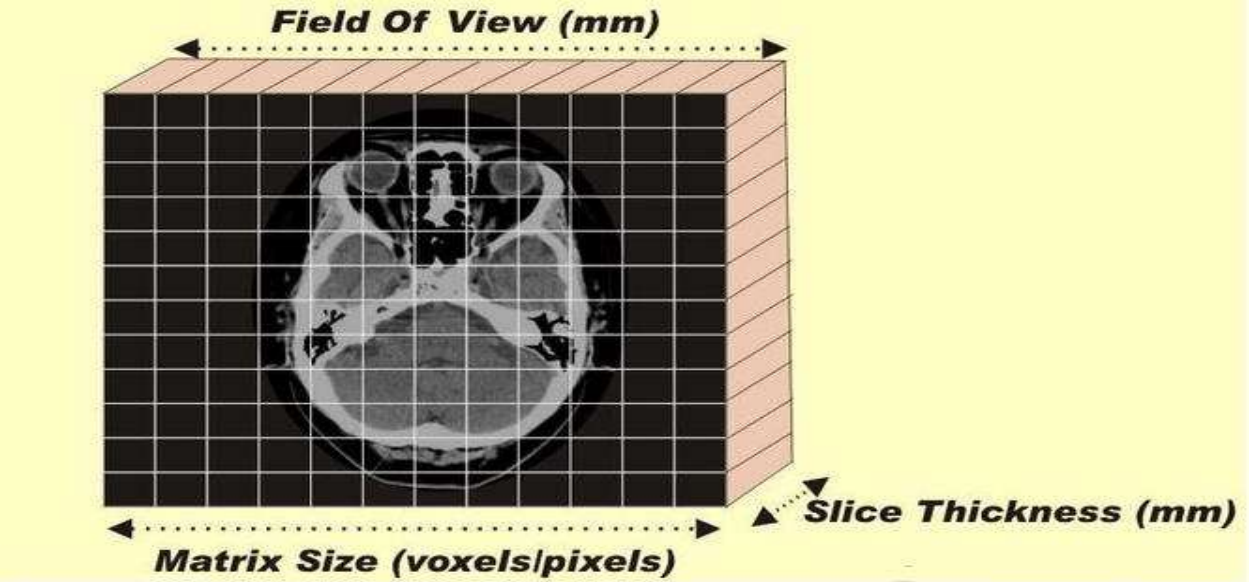


Fig 5: Representation of slice thickness. FOV and matrix size are also shown.

1.2.4 Image Noise: Image noise was highest at the center of the reconstructed image and decreased towards the edges [18]. Noise in CT is measured via SNR comparing the level of desired signal (photons) to the level of background noise. The higher the ratio, the less noise is present in the image.

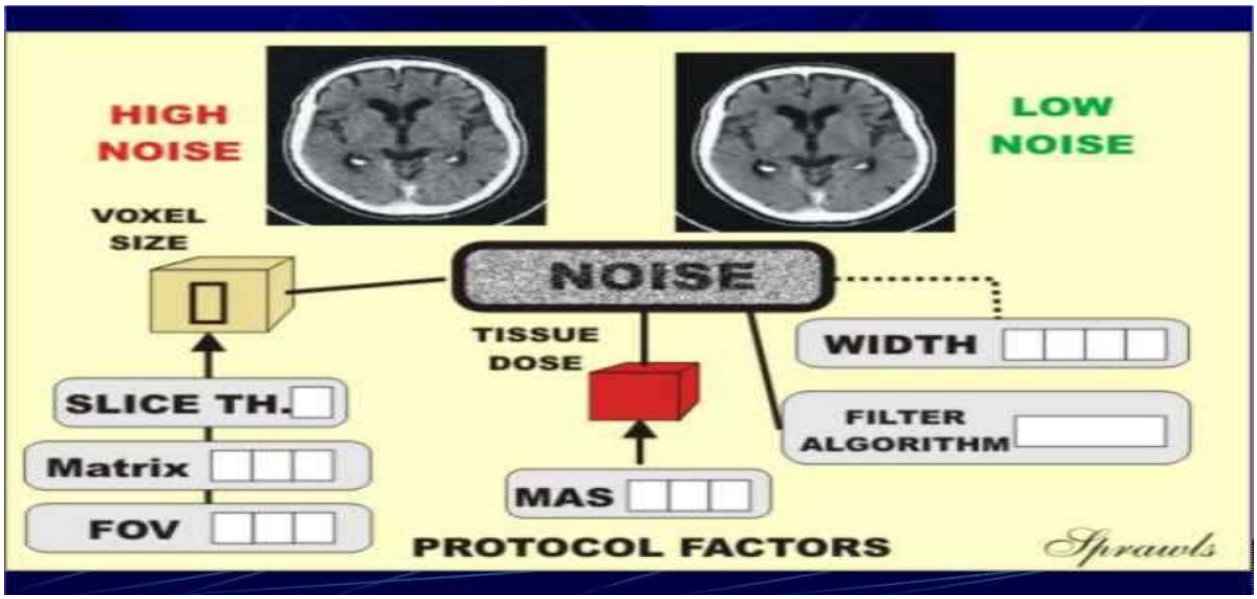


Fig: -6 The Factors That Affects the Noise in a CT Image

1.2.5 **Pitch:** The dose received by the patient long the longitudinal axis, i.e., along the table have inverse relationship with pitch. If the pitch is increased, the dose will be reduced. Thus, pitch has to be adjusted accordingly to the protocol to reduce the patient dose [19]. For single slice helical CT scan the higher the pitch, the lower the dose. Spiral artifacts are reduced at lower pitch settings. The use of high-pitch protocols gives high diagnostic imaging quality with low radiation doses [20].

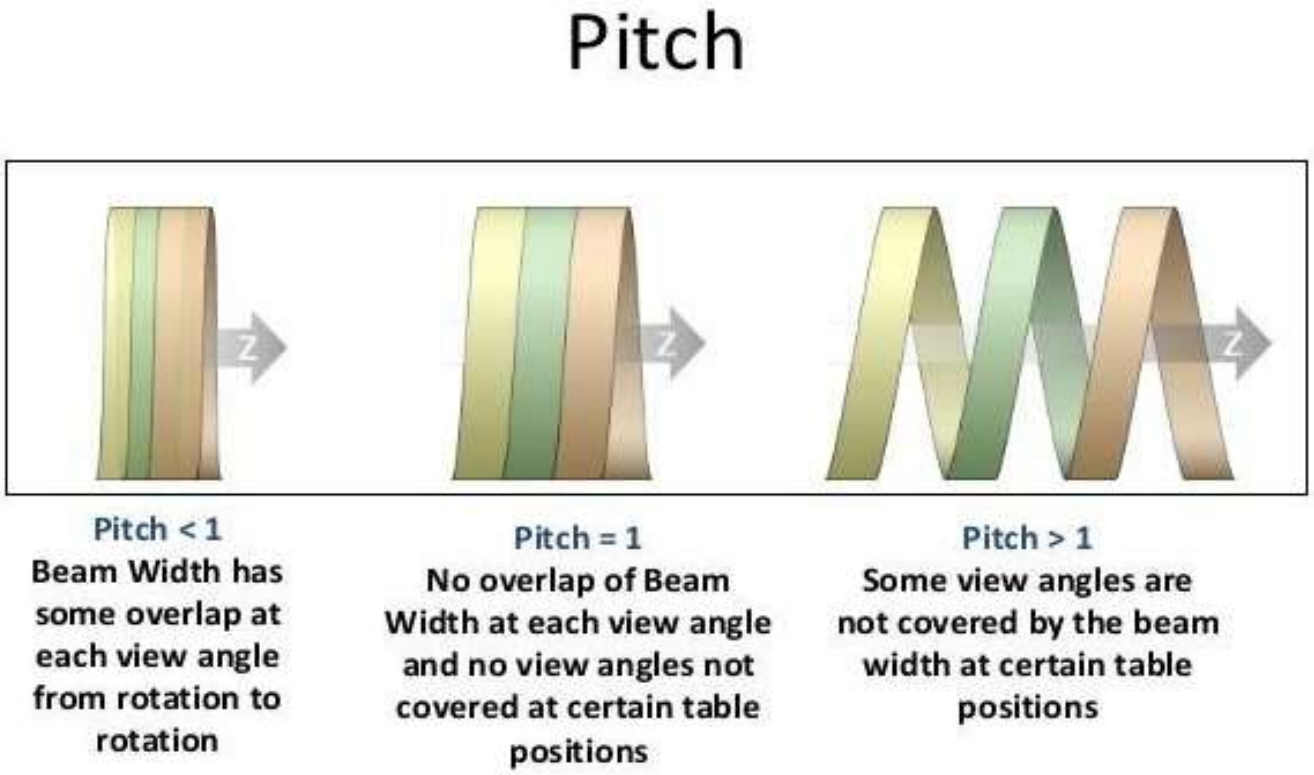


Fig 7: - Pitch value in CT scan

1.2.6 **Automatic Tube Current Modulation (ATCM):** ATCM (Automatic Tube Current Modulation) in CT scan can achieve reduction in patient dose, The main objective of ATCM is to modify the tube current during the CT scan in order to fit patients of various sizes while maintaining excellent image resolution during the scan [21].

Understanding the knowledge of CT exposure parameters among working professionals in radiology department to predict and create awareness about the various effect of radiation on patients as well as to the various working professionals.

OPERATIONAL DEFINITIONS

1. CT (Computed Tomography)- This diagnostic imaging test used to create detailed images of viscera (liver, kidney, spleen, intestine, etc.), bones, soft tissue (fat, muscles, etc.) and blood vessels (artery, veins, capillary). It is quick, painless, noninvasive and precise.

2. Radiographer- An allied healthcare practitioners who uses CT scans and other radiological imaging methods to get medical images to diagnose diseases and injuries.

3. CT exposure parameters- Parameters such as kilovoltage peak (KVp), milliampere seconds (mAs), slice thickness and so many which helps in increasing or decreasing radiation dose for satisfactory image quality.

4. Knowledge- In this study knowledge of radiographers is about CT exposure parameters adverse impact on patients.

5. CT Technologist- An allied health professionals who done CT scan to diagnose diseases and injuries.

NEED OF STUDY

Our study is to impart knowledge to the radiological staff about knowledge and awareness of CT exposure parameters. Also, this study highlights the need of the exposure parameters and their impact that are utilized in CT examination, such as tube current-time product (mAs), peak kilovoltage (kVp), slice thickness, pitch, noise and automatic tube current modulation (ATCM), that directly impact the radiation level and the quality of CT scan images while keeping their knowledge upto date. While performing CT examination, their ignorance of ALARA eventually results in higher radiation doses for radiological staff and patients together. So, all these events which I experienced during my graduation period and during internship lead me to do research work to create awareness among various radiographic professional about CT parameters so that they can use possible low dose of exposure during the radiographic examination. To encourage radiological staff members to alter CT scan parameters that have been implemented with the latest version of CT scan for patient safety. To create awareness among various radiographic professional about CT parameters so that they can use possible low dose of exposure during the radiographic examination.

CHAPTER – 2

AIM & OBJECTIVE

AIM & OBJECTIVE

AIM - Assessment of knowledge and awareness of radiological staff regarding computed tomography exposure parameters in Delhi NCR hospital and diagnostic center.

OBJECTIVE - The goals of the research are as follows: –

- To seek relation between the knowledge of Radiological staff (CT Technologist and Radiographer) according to selected demographic variables data such as age, gender, qualification, work experience.
- To assess and enrich the current knowledge of radiological staff (CT Technologist and Radiographer) and to get good quality image regarding CT exposure parameters.
- To create awareness among radiological staff about the consequential effect on patient dose safety.

CHAPTER – 3

REVIEW OF LITERATURE

3 LITERATURE REVIEW

3.1 Hollingsworth C, Donald P. Frush…et al, 2002 conducted a survey of members of the society for paediatric radiology at Duke University Medical Centre was used to evaluate the current use of helical CT of the body in paediatric patients in 2000. A consistent resource locator link was provided by email to 765 members of the Society for Paediatric Radiology in order to evaluate a web-based survey. 53 questions made up the survey. They asked about demographics, the administration of oral and IV contrast media, and age-related scanning parameters (such as tube current, kilovoltage, slice thickness, and pitch) depending on age groups (0–4, 5–8, 9–12, and 13–16 years). The standard resource locator link included in an automatic weekly email delivered for three weeks to all members of the Society for Paediatric Radiology allowed respondents to access the web-based survey. Results of the survey were automatically calculated. The study concludes that age-adjusted helical CT is performed by paediatric radiologists, and that various scanning procedures are employed, which may result in the delivery of high radiation doses. Future suggestions and research into helical CT in paediatric patients can be informed by knowledge of present procedures for helical CT of the body in children [22].

3.2 Nevzat Karabulut, Macit Ariyurek…et al,2005 conducted a survey-based study on practices and policies in radiology department of institutions in Turkey in 2004 regarding the use of low dose CT in daily practice. Questionnaire was based on practices and strategies comprising of 8 question which was distributed in 40 radiology departments in Turkey and asked to fill the questions by just one participant from each department, while the responded was asked to complete the questions and return it by emails. Out of 40 only 33 responses were received 39% reported to have only single slice helical CT, 9% have multislice CT, 6% have only conventional non helical CT and rest of them have both single helical CT and multi slice CT. 85% responded that they modify CT scan parameters to reduce the patient dose and only 18% reported that they modulate the scan parameters, 36% often, 39% sometimes and 7% seldom. In pediatric and pregnant

patient reduction in dose is reported by 93% and 57% of respondents. The conclusion of the study is that the majority of responders are conscious of low dose CT but the frequency of application varies considerably in routine practice. Reduced mA and increased pitch are the most commonly used modifications. Limitations where it is limited to academic radiologist who are aware of low dose strategies than public or private hospitals radiologists and other was There could only be one answer from each institute and that doesn't show the work of whole department as interindividual variation in the work pattern occur [23].

3.3 Desislav Stoyanov…et al. 2009 conducted a study on influence of exposure parameters on patient dosage and image noise in CT scan in Bulgaria hospitals. The primary aim of this research is adjustable by the operator CT exposure parameters that affect radiation exposure and image noise. The study was performed on five clinical CT units, all of them of third generation –- 1 was GE Prospeed Plus, 2 was GE Bright Speed 16, 3 was Siemens Somatom AR.C, 4 was Siemens Somatom Emotion and 5 was Siemens Somatom Emotion Duo. First four CT units were single sliced and unit 5 is dual sliced systemAn axial scanning mode study was conducted to examine the impact of primary exposure parameters on dose to patients and image noise. It was measured with Ionisation chamber in pencil form, type TW30009, having an active length of 100 mm, connected to a radiation measure device Unidos E type T10-009 (PTW Freiburg, Germany). Water phantom from the set of every particular scanner was used. The acquired data were applied to the study of exposure parameter effects on CTDI air and image noise. The study concludes that exposure parameters on dosimetry quantities and image noise demonstrated the basic ways for dose and image noise optimization for CT units without AEC systems. It is not possible to directly compare the results between different scanners because of the current variations in scanner design and beam characteristics. The alteration of tube voltage and tube current show the potential in patient dose reduction up to 50% but may deteriorate image quality, and has to be carefully applied for every particular scanner. The optimization of clinical protocols is possible but has to be done taking into account the specific clinical task [24].

3.4 Al Mohiy H, Sim J. et. al. 2011 conducted a study on Differences between Saudi Arabian and Australian radiographers' knowledge and attitudes about pediatric CT doses in RMIT University in October 2009. A survey questionnaire was designed and had two sections of background information and CT information. The questionnaire was distributed to seven public hospitals in Australia and eight public hospitals in Saudi Arabia. Each package consisted of an invitation to participate in the survey, a plain language statement, the questionnaire, and a postage-paid return envelope. Version 18 of the SPSS program was used to analyse the data. The study results that 56 of 71 eligible Saudi Arabian radiographers (79%) and 50 of 83 Australian radiographers (60%) participated. Study concluded that Australian and Saudi Arabian radiographers working in pediatric hospitals differ in their knowledge bases. Knowledge can be improved through enhancement of hospital protocols and continuing education and training, and will cause paediatric children to be exposed to less radiation [25].

3.5 S.J.Foley, M.G.Evanoff…et al 2013, conducted a questionnaire survey was given to a group of 65 radiologists who were taking the American Board of Radiology test in November 2011 in order to assess the radiologist's and clinical specialist radiographers' (CSR) understanding of CT parameters and how they affect patient dose and image quality. There were forty questions in the questionnaire, covering CT parameters and how they affect the dose given to patients and the quality of the image. He conducted an examination of the data using either the Mann Whitney U test or the independent samples t-test, based on the findings of the Kolmogorov-Smirnov normalcy testing. 22% of radiologists and 32% of CSRs responded to the study, based to its findings. While there was no discernible difference in mean scores between the two groups, there was a significant variance in the comprehension of CT parameters. The required diagnostic reference values were unknown to radiologists, although groups expressed worry about the amount of CT radiation in their departments. The study's outcomes indicate that while both groups possess a high level of understanding regarding CT parameters, there are some observed shortcomings that may have an impact on patient doses and restrict their potential in clinical practice [8].

3.6 A R Farajollahi, D F Fouladi…et al, 2014, conducted a study on A questionnaire survey conducted in the Tabriz, Iran, metropolitan area examined the professional knowledge of radiologists regarding safety concerns and factors in plain radiography from July to November 2013. Two sections were created for the questionnaire: the first contained demographic data, while the second covered radiographic imaging parameters and safety concerns. Every medical imaging facility had collecting boxes available, and all radiologists were requested to submit the questionnaire within three months. The software SPSS® v. 16 (SPSS Inc., Chicago, IL) was used for data analysis. The questionnaire was completed by 120 radiographers in total, representing a 63.8% response rate. The study comes to the conclusion that a radiographer's professional expertise can be reliably predicted by their academic background. It is very advised to take refresher classes and do regular knowledge evaluations [26].

3.7 M K A Karim, S Hashim…et al,2016, conducted a study on radiology staff members' awareness and knowledge of radiation dose and the state of computed tomography technology in Johor, Malaysia in 2015. Subjects were split into two groups (medical profession 32 and allied health profession 88), and a total of 120 questionnaires were created, divided into three sections (demographic data, relative dose of radiation, and knowledge of current CT technology). The questionnaires were then distributed to 120 radiology staff members working in seven public hospitals. Version 17.5 of the SPSS program was used to analyse the data. Of the 120 respondents, 56% had fewer than three years' experience, 82% were unaware of how to change CT parameters, 68% had heard of the Basic Safety Standard Regulation (BSS), and 80% had taken an associate course. The accurate estimate of equivalent dose is known by 25% to 92% of Med and 17% to 92% of AH. As per the study's findings, the majority of radiology staff members are aware of the radiation doses given to patients, however they lack expertise in CT optimisation methods. It is advised that future research be done with an emphasis on comprehending CT quality of images [3].

3.8 Kumari Pinki, 2017 did a study assessment of medical students' understanding of radiation risks related to radiological diagnostic imaging procedures from March

2014 to May 2015. Two sections of a questionnaire are prepared, first was demographic information and second was awareness and awareness of the radiation risks connected to diagnostic imaging and distributed to 480 medical students. Results were stratified according to gender difference, previous exposure to instruction or lectures/teaching in diagnostic radiology, teaching in radiation protection and perceived knowledge of radiology. All the results were analyzed by SPSS software 16.0. Chi-square test and one way ANOVA was used for the evaluation of level of significance. Although an increase in knowledge of students of medicine with advancing professional year is seen, there is lack of overall awareness so further educational classes were required [27].

3.9 Hanan Elnour, Hussein A Hassan…et al, 2017 did a study on Evaluation of Components of quality of the image for Computed Tomography in Sudan in June 2014 to August 2016. The study aimed to assess image quality parameters, mainly noise, and radiation doses during abdominal examination. The study applied was experimental and carried out in four CT centers in Sudan in which A unique data gathering sheet was created that has inclusion criteria of DLP, image noise and CTDIvol. This study shows the diagnostic parameters (kilo voltage, tube current time product, slice thickness, and pitch) and their effects on radiation exposures from computed tomography scanners employing phantom images as well as the quality of the image. In order to conduct the statistical analysis, the software statistical package for the social science (SPSS) version 18.0. At Elnileen diagnostic center An increase in kVp values results in a 92% increase in radiation dosage and an 83% decrease in image noise. At Antalya medical center, increasing in kVp values led to an rise in the radiation dose by 35% and a decrease in the image noise by 26%. The study concludes that To reduce patient radiation dose from CT scanners, manufacturers, radiologists, technologists, and physicists must collaborate to develop a strategy based on the ALARA Principle [28].

3.10 Haytham Al Ewaidat, Zheng X…et al, 2018 conducted a study on patients' understanding and awareness of the risks and dosage of CT radiation in Jordan between September 2014 and march 2015. A questionnaire was created that consist of 24 questions and two sections of (demographic and their perceptions regarding radiation,

possible risks, and protection). The questionnaire was distributed at six local Jordanian hospitals that had diagnostic imaging departments. Utilising SPSS software version 24.00, the data was examined. Six hundred patients completed out of which 52.33% of respondents were female and 47% males. 90.7% didn't have education regarding radiation. 53% 53% patients have examined with ionization radiation. 40% knows that radiographers could alter the scan parameters. 56% indicated that there is difference in radiation dose from one exam to another. 37% patients were aware of wearable radiation protection tools with the CT examination. The study concluded that Jordanian patients had a lack of education and awareness about the degree of ionization radiation used for a CT and the risks that come with it. The results also have identified limited radiation protection awareness among these particular patients. Hospitals should also be involved and take the lead in encouraging patient education to increase general awareness and overall knowledge about radiation safety and awareness [29].

3.11 Mohammad Rawashdeh, Sarah Lewis...et al, 2018 created a survey on social media and gathered information from 54 CT radiographers in Jordan to look into the expertise and practices of those working in the field. Questionnaire was created on four parts demographics, an assessment of one's knowledge on CT scan exposure, modification to CT exposure, dose unit, and DRL which comprised of 36 questions. He used independent sample t-tests, Kruskal-Wallis H tests, Mann-Whitney U tests, and Chi-square tests for evaluating this data. The result of this examines showed various qualifications had seen in 54 participants with the majority possessing a bachelor's degree (n=35,64.8%) and diploma(n=19,35.2%). 48 radiographers successfully completed the questionnaire, no participants correctly answered All DRL values for CT scans of the abdomen, brain, and chest, but 4 (7.4%) know the chest value, 3 (5.6%) know the abdominal proportions and just 2 (3.7%) know the brain value. In general, radiographers had a fair understanding of how each exposure parameter related to the patient's dose and image quality, based on the study's findings. However, the sequence of the organ radiation sensitivity and the DRL value were poorly understood [6].

3.12 Farshid Mahmoudi,Mozafar Naserpour…et al, 2019 conducted a questionnaire research to evaluate the knowledge of CT technologists and radiographers on CT exposure parameters in 2018 among 113 radiographers and 103 CT technologist in Khuzestan(southwest of Iran). Three sections made up the questionnaire that containing demographic characteristics, general opinion on CT scan dose and question assessing technologists' knowledge of CT exposure parameters. Software from SPSS was used to analyse the data. Overall understanding of CT exposure factors is demonstrated by the study's result among radiographers was 36 and among CT technologists was 42. Conclusion of the research illustrated that the knowledge of scan parameters affecting dose and image quality among radiographers and CT technologist was very low [21].

3.13 Sharma BR, Singh S…et al, 2019 conducted a study on Knowledge of radiation exposure and its risk among radiographers and radio technologist in Pokhara, Nepal in 2018. Throughout the three months of September through November 2018, a questionnaire assessment was conducted at various hospitals and diagnostic centers that contain nineteen questions and handed out hard copy and request to complete in 20 minutes. Descriptive statistics was used to analyze data using SPSS v25 and Microsoft Excel 2013. Result was of total 103 participants 53.4% were males and 46.6% were females. Only 8.7% used dosimeters to measure the radiation dose. This study illustrated that the knowledge and the perceptions regarding the effects of radiation and radiation protection among the radiographers/technologist is just satisfactory and needs to be improved. Study recommended that further workshops, seminars, symposium, training courses and Continuing Medical Education (CME) programs are recommended on a regular basis in collaboration with ISSRT and other domestic and worldwide organisations to increase radiation awareness. Limitations were time affected the answers and the opinion of the participants [30].

3.14 Ali Adam Muhammad, Abubakar Auwal…et al, 2019 conducted a study on knowledge of computed tomography exposure parameters and common radiological examination doses among radiographers in teaching hospitals in northers Nigeria in

2019. A questionnaire is created that consist of 21 questions in MCQ formats and divide into three sections, first is demographic features, second is radiographer's understanding among CT scan exposure parameters and third is radiographer's knowledge regarding common radiological examinations doses. The statistical package for social sciences (SPSS) was used to analyse the data (version 20.0; SPSS Inc., Chicago, IL, USA). A total of one hundred and fifteen (76.7%) radiographers from teaching hospitals in Northern Nigeria participated in the study and correctly filled and returned. Majority of the respondents (66.1%) were males while the leftover (39 .9 %) were females. There was no discernible difference in the level of understanding of the radiographers about CT exposure parameters and dosages from standard radiology exams based on the highest level of education. The study finds that radiographers have a strong understanding of CT exposure parameters, poor knowledge of radiological examinations doses. However, Knowing the CT exposure parameters did not change in a statistically meaningful way and common radiological examination doses among radiographers in teaching hospitals in Northern Nigeria based on highest academic qualification. Due to the analysis, there should be ongoing education in dose optimization for radiographers at all level. Radiographers must adopt appropriate CT parameters and regular training courses for all undergraduate, post graduate as well as for radiographers must be considered for patient safety [31].

3.15 Serigne Moussa Badiane, Pape Ibrahima Sane…et al, 2019, conducted a study on Evaluation of the understanding of CT Scan Prescribers on Patients' Radioprotection in Senegal in 2019. A questionnaire was created that distributed to 10 hospitals to 107 were submitted to doctors and among them 102 responded. This distribution corresponds to 49% of doctors in training and 51% of senior doctors. The majority of doctors claimed to have considered the concerns associated with induced radio risks, but the results demonstrated that their understanding of these risks was lacking. The study concludes that current upgrading of the imaging technical platforms of the main national hospitals as well as regional hospitals is turning training needs into a real emergency. The lack of continuous training of medical staff and patients on radioprotection is a disadvantage and a potentially serious risk due to the diverse profile

of the staff and equipment installed in health services [32].

3.16 Bouchra Amaoui , Abdennasser El Kharras…et al, 2019 conducted a study on Knowledge of Physicians in a Moroccan Hospital Regarding X-ray Exposure from CT Scans in 2019. A questionnaire is designed with 16 sections, The first was demographic data; the second was the frequency with which physicians ordered CT scans; the third was the knowledge of physicians regarding radiation dosages; and the fourth was the knowledge of physicians regarding the possibility of cancer induction following an abdominal or pelvic CT scan. The statistical package for Microsoft Office Excel 2007 was used for evaluating the data. The result shows that just 10% of doctors follow the guidelines when prescribing CT scans, despite the fact that ninety nine percent of practitioners recommend them for patients during actions. The study concludes that the physicians' inadequate understanding of the radiation exposure. The expertise and techniques of CT prescribers could be greatly enhanced by ongoing training in complex radiation protection for patients [33].

3.17 F.M. Aldhafeeri…,2020 conducted a study on Saudi Arabian radiogrphers awareness of the ionising radiation dosages that patients get during routine radiographic procedures, in 2019. Two sections and twenty-one questions were included in the questionnaire that was created, first were demographic information of 4 questions and second were radiation dose and risk of 17 questions. Software called SPSS Statistics was used to analyse the data, version 14.0, to obtain frequencies, percentages, and descriptive statistical results. Out of 180 questionnaires distributed, 100 were completed and returned. These findings demonstrated radiographers' shockingly low degree of radiation dosage and risk understanding. The majority of radiographers underestimated radiation doses and related hazards from routine radiological exams, based on the findings of this study. Radiation protection and dose are not covered in any of the diploma programs that the majority of radiographers possess. It needs ongoing professional development in radiation safety to work as a radiography technician [34].

3.18 Sundaran Kada...et al, 2020 conducted a study on Norwegian student radiographers understanding of CT exposure parameters, these are in their final semester of the study prior to graduating in June 2019 and data was collected in March 2019. A questionnaire with 21 questions were designed related to CT exposure parameters and verbal consent was taken. Questionnaire was distributed to students' radiographers with CT machine on campus and other without CT machine on campus SPSS software version 25 was implemented to analyse the data. The result shows that 101 questionnaire was distributed and 72 students returned the questionnaire, resulting in a 71% response rate. The mean scores for the student's knowledge were 53%. No one answered all the questions correctly. Twenty-six students (36%) answered more than 50% incorrect and only 24 (33%) correctly answered on kVp and mAs questions. Between students who had access to CT facilities on campus and those who did not, there was no discernible difference in knowledge. The study concludes that students' radiographers have a satisfactory knowledge that demonstrates a very limited degree of judgement and independent thinking. It also concludes that the student radiographers from the school with a CT machine on campus are not as knowledgeable about CT exposure parameters as expected. The findings can recommend that educational curriculum needs to be revised and updated with the importance of understanding of the criteria for CT exposure during lectures [35].

3.19 Hussain M Almohiy,Khalid Hussein…et al, 2020 conducted a survey investigating Saudi Arabian radiologists' knowledge and opinions regarding the radiation dosage from CT scans and the exposure dose from paediatric patients in 2020. A questionnaire was developed using CT data and dispersed at random among 600 radiologists in the Kingdom of Saudi Arabia; only 101 of the responses were examined in the end. Statistical Product and Service Solution (SPSS) version 20 was implemented for analysing the data. The Cronbach's alpha (0.871) was computed to assess the data's trustworthiness. Out of 600 radiologists, just 101 (16.8%) from various health sectors completed the questionnaire, based on the study's findings. Of the participants, 70.7% held a PhD or MD, 13.8% held a Master's degree, 13.8 percent had an MBBS, and 1.9% held a postgraduate diploma. Of those, 50% had more than ten years of radiological

experience. While the majority of participants (65%) were aware of the dangers connected with the CT radiation dose during paediatric exams, only 48.5%, 56.5%, and 65% of participants were aware of the specific concerns associated with paediatric exams of the head, chest, and abdomen, respectively. The study's outcomes demonstrate that radiologists had an adequate understanding of the overall danger that paediatric children face from CT radiation doses, but there was variation in their awareness and understanding of the risks and CT doses related to certain protocols [36].

3.20 Mohamed M.Abuzaid, wiam Elshami…et al,2020 conducted a investigate to evaluate the expertise and practice of CT clinical practice preceptors in terms of CT parameters affecting patient dose and image quality on clinical training students by the medical diagnostic imaging division of the university of Sharjah in 2020. A self-structured two parts were created for the questionnaire, the first section includes in demographic information, training and the current protocol used in their facilities and the second section is based on knowledge comprises of 18 questions. Data analyzed were done by using excel and the SPSS version 25. The result shows the response rate was 92% in which 69% are males and 31% are females aged between 24 and 59 years. The average knowledge score was 72.2% with a range of correct answer of 9-18, the participants showed a low awareness of diagnostic reference levels but they had good overall knowledge with a potential for improvement and confidence in practice. The study concludes that continuous medical education and professional development are a priority for improvement to ensure reliable delivery of health care and best practice. The findings can be used to design educational programs to ensure the highest training and performance of their technologists [4].

3.21 M K Abdulkadir, Albert D Piersson…et al, 2021 did a study on assessment of diagnostic reference levels awareness and knowledge amongst CT radiographers in Northern Nigeria between June and November in 2019. A cross- sectional study is designed and distributed to certified medical radiographers and There are three sections with fifteen questions total i.e. in first is demographic, second is awareness about essential

general radiation protection and optimization in CT and third is knowledge and awareness about DRLs and its application as an optimization tool. The correctly perceived knowledge of DRLs was 45.5%, dose optimization 42% and CT dose descriptor was 39%. An analysis of the data was done using the SPSS software version 20 (SPSS Inc., Chicago, IL). The study concludes that deficiencies were noted in radiographers' knowledge about DRLs with precise knowledge gap in the execution of local dose survey for DRLs and optimization. It is necessary to continuous radiographers' training with greater emphasis on dose optimization and institutional based dose evaluation [37].

3.22 Wahyudi Ifani, B Soeprijanto…et al, 2021 conducted a study on Evaluation of Radiographers Experience and Knowledge Related to Estimation, Radiation Dose Comparation, and CT Parameters in Kota Medan, Indonesia, in February- April 2020. A questionnaire was conducted which contains 60 questions in three sections of characteristics, experience and knowledge and distributed to 33 radiographers from three hospitals in Kota Medan. Excel and SPSS version 25 were used for data analysis. The result shows that average knowledge value of respondents is 56.3% and none of respondents answered correctly. The study concluded that low radiographer knowledge related to dose estimation and CT scan parameters. Further training or courses related to CT Scan optimization techniques need to be pursued again in hospitals for radiographers [38].

3.23 Eddy Fotso Kamdem, Odette Ngano Samba…et al, 2021 conducted a study on an evaluation of CT scanner operators' understanding of how to use Automatic Exposure Control (AEC), a dose reduction program, during a scan in Cameroon from January 1 to December 1, 2020. The following three components of the questionnaire were designed: first, it asked for demographic data; second, it evaluated practitioners' understanding of how to apply dose reduction software during a computed tomography examination and third part was requiring practitioners if they had already received patient radiation protection training and distributed to 80 participants in 10 radiology of Cameroon's public and private hospitals with a CT scanner. Excel software

was implemented to process the information that was collected. 75% of medical imaging technicians had been in practice for more than 5 years. Finally, only a third of the practitioners had received training in patient radiation protection. The study comes to the findings that user-specified adjustments to the quality of image or patient radiation exposure can be achieved through the use of automatic exposure control (AEC) devices. Understanding the variations between various CT systems is crucial for medical imaging technologists, as these distinctions can be helpful when developing CT radiation dose optimisation strategies. Based to this survey, implementing AEC systems to lower radiation exposure is very beneficial [39].

3.24 Abdulrahman Tajaldeen, O A M Kheiralla…et al, 2022 conducted a study on Assessment of Paediatric Imaging Modalities Practices by Radiologists and Technologists: A Survey-Based Investigation conducted in Saudi Arabia between April 15, 2021, and July 15, 2021. Three sections and fifteen questions make up the questionnaire, which was distributed to 26 hospitals in Saudi Arabia. The first section asked questions about demographics related to employment, the second section asked questions about general demographics, and the third section asked about practices the participants adhered to when doing paediatric CT. 117 collected from technologists and 49 collected from radiologists. A Microsoft Excel spreadsheet was used to populate and insert all of the data for analysis. The study's findings were categorised based on the diagnostic orders that radiologists made for paediatric patients as well as the procedures that technicians now followed to reduce the amount of radiation that they exposed youngsters to. According to the study's findings, children who get CT scanning may be exposed to radiation, which could raise their risk of developing cancer in the future. As evidenced by the fact that 63% of the technologists in this study employed lead aprons to safeguard paediatric patients, the majority of them adhere to radiation protection standards. Radiation awareness education for technologists could lower radiation risks for paediatric patients and increase their understanding of the health benefits of wearing lead-based aprons [40].

3.25 Abdulaziz Qureshi, Walaa Alsharif…et al, 2022 conducted a study on Evaluating the level of understanding regarding computed tomography parameters and their effects on radiation dosage and the quality of image between radiographers and undergraduate students in Medina, South Arabia in 2022. A questionnaire was conducted at four hospitals in Medina KSA (Kingdom of Saudi Arabia). The questionnaire consisted of 12 close-ended multiple-choice questions (MCQs) related to computed tomography technical parameters and CT exposure factors such as pitch, slice thickness and reconstruction algorithm were given to each participant via hardcopy or online using a web link. A 22 version of SPSS software was used to analyse the data. 40 questionnaires given to both radiographers and undergraduate students in which 35% of the respondents were from level eight, 27.5% were from level six students, 22.5% were from internship students and 15% were from employeesThe study comes to the conclusion that while employees in this study are technologists with diploma degrees and no formal continuing education, most students have knowledge from their ongoing undergraduate studies, and this indicates that the level of understanding of the CT parameters differs among students and employees. The majority of the questions were accurately answered by the students. Only few questions sparked controversy because of the major difference of answers when both groups were compared. The primary cause of this could be attributed to the differences in the respondents' educational qualification. The employees in this research were only technicians with diploma degree. Level 6 students who were unable to fully comprehend CT and are still undergoing the CT course. Level 8 students answered fairly well, but there were certain restrictions that would call for additional training, additional classes, or additional internet resources. To preserve the precision of CT parameters, the need for ongoing education is inevitable [41].

3.26 Shrooq T. Aldahery…et al, 2023 conducted a study on assessment of radiographer's knowledge about radiation doses and DRLs in computed tomography departments in Jeddah, Saudi Arabia from February to March 2022. An online questionnaire with 22 questions was designed in three sections. Information on demographics is included in the first section, general information on radiation doses is included in second section and DRLs (diagnostic reference levels) is included in third section. The tools used to analyse

the data were SPSS statistical package (IBM SPSS Statistics version 26, PASW, Chicago, IL). Total 169 radiographers participated in the study in which 91% aware about ALARA principle, 47% participated indicated that routine scanning protocols are designed by radiologist and 78% were confident in manipulating the parameters and 53% were aware of $CTDI_{vol}$ and DLP. The study concludes that radiographers demonstrated good knowledge of radiation protection, less awareness of DRLs among radiographers and lack of implementing and optimizing the local dose of the DRLs. Education and training for radiographers and healthcare professionals to enhance clinical practical performance in radiology departments [42].

3.27 Zahra Kazemi, Khadijeh Hjimiri…et al, 2023 concluded a study on **evaluation of radiographers and CT technologist level of understanding regarding computed tomography parameters in August and September 2020 in Zanjan provincr (northwestern Iran).** An online questionnaire with 53 questions was designed into two sections and distributed to 153 radiology personnel. The first section includes 13 questions on demographic and occupational characteristics and second section includes 40 questions on advanced CT scan protocols and parameters. Version 22 of the statistical software SPSS was used to analyze the data. The result shows the response rate of 61% in which 30 are radiographers and 64 are CT technologists. CT technologist had a highest and lowest knowledge score in image reconstruction and mAs whereas radiographers had highest and lowest scores in the field of image noise and kVp. The research findings indicate that the total knowledge scores of CT technologists and radiographers for various scan parameters affecting image quality and dose were insufficient. The findings can be recommended that regular training and courses be held to enhance and update technologists' knowledge [9].

3.28 Mohd Hafizi Mahmud, Mohd Amirul Tajuddin…et al, 2023 conducted a study on knowledge and practices of Computed tomography exposure parameters among radiographers in Malaysia in 2021. A cross-sectional survey is conducted on 60 radiographers who are practicing CT in a teaching hospital in Klang Valley, Malaysia. and

the questionnaire contain three sections, first was demographic information, second was acquired knowledge of the radiographers concerning CT exposure parameters and the third was the current practice of radiographers concerning CT exposure parameters in their clinical CT practice. The statistical analysis was carried by utilising SPSS version software 26.0 for Windows (SPSS Inc., USA) with a p-value was deemed statistically significant. The results demonstrated that the radiographers had good scores (76.5%) and excellent scores (88.3%) in knowledge and practice, respectively. The study concludes that good knowledge and excellent practice on CT exposure parameters which have an impact on the quality of the image and on the CT dosage of radiation to the patient were found among radiographers but improvement of knowledge in some parameters. More continuous education programs, courses and training on CT dose optimization are essential for radiographers in the future [43].

3.29 Badera Al Mohammad, Maram M Alakhras…et al, 2023 conducted a study on assessing the knowledge of CT radiographers regarding the optimization of CT parameters and their consequential effects on both patient radiation dose and the quality of image in January 2023 in Jordan. Two sections were created for the questionnaire one is demographic and second is CT parameters. Two of the questionnaires were excluded because of incomplete responses. Three hundred and fifty-seven radiographers participated in the study, working in different sectors {private (33.8%), public (40.8%), university (13.2%) and military (12%)} were included in the study, with a mean knowledge score of 69.0%. Participants with an academic master's degree had a significantly higher score of 72.1% compared to the ones with a diploma degree, with a score of 66.8%. The results demonstrate that radiographers have an overall good understanding of CT parameters, with academic education having a significant influence on their performance. The study concludes that by prioritizing the provision of such education, radiographers can develop the necessary skills to optimize CT parameters effectively in clinical practice. This will ultimately contribute to improved patient care by ensuring appropriate dose optimization while maintaining the required image quality for accurate [44].

3.30 Faisal H Alsubaie…et al, 2024 conducted a study on knowledge and perception on radiation risk associated with computed tomography scans for patients visiting an emergency room in Saudi Arabia in 2022. A questionnaire was designed with 15 questions including demographic information and patients' knowledge of radiation used in medical imaging and distributed to 357 patients who visited emergency room in Riyadh, Saudi Arabia, at the King Khalid University Hospital from December 2022 to January 2023. Using IBM SPSS Statistics, statistical analyses have been carried out for Windows, Version 26 (Released 2019; Armonk, IBM Corporation, New York). The study's outcome was there were 357 responses to the questionnaire, with 157 (44%) men and 200 (56%) women. The largest number of patients fell within the 21-40 age group (48.2%). This study concludes that highlight a lack of information about radiation and its potential risks provided to patients prior to the diagnostic procedure. Increasing awareness and understanding of the risks associated with these imaging modalities should be considered essential in modern communities. Efforts should be made to ensure that patients undergoing diagnostic imaging are aware of the radiation risks they may encounter [45].

CHAPTER – 4
METHODOLOGY

METHODOLOGY

4.1 STUDY DESIGN: A cross-sectional study.

4.2 STUDY AREA: Radiological staff (CT Technologist and Radiographer in radiology department from various Delhi NCR Hospitals and Diagnostic centers.

4.3 SAMPLE SIZE: The sample size is given for CT Technologist -123 and for Radiographer – 123.

4.4 MATERIALS AND METHODS: A cross-sectional study that used a self-administered questionnaire and was conducted at the Radiology Department of multiple hospitals and Diagnostic centers in Delhi NCR. A self – designed questionnaire is created to access the knowledge of CT exposure parameters. The questionnaire is reviewed and approved by the head of the department.

4.5 DATA COLLECTION PROTOCOL: The questionnaire including MCQ, Yes / No format. The questionnaire developed into two sections that contained a total of 33 questions. The first section collected is demographic and occupational characteristic information of the radiological staff (10 questions) such as age, gender, educational qualification, CT scan protocol decision is taken by, confidence in altering protocol, work experience of radiological staff, etc. The second section is the CT exposure parameter (23 questions), which includes questions on kVp, mAs, pitch, noise, ATCM, etc. One (+1) point is awarded for each accurate response and zero (0) points are awarded for each wrong response. This means that a higher score means better knowledge. The online Google form is used to gather data, and radiological staff are notified via email and social media and it is emphasised to participants to fill out the questionnaires using only their own expertise, without consulting books or other sources. Acquired data will be tabulated, and the result will be used for descriptive statistics.

To calculate the mean of each participant's response knowledge score in percentage terms, the total score obtained by each person is divided by the sum of the expected scores and multiplied

by 100. Then the mean scores of all participants were calculated to obtain the total knowledge score.

4.6 STATISTICAL ANALYSIS: The data was input into an Excel spreadsheet and subsequently statistical analysis of the information was performed by S- Test. A P-value <0.05 for every test, was deemed to be statistically significant.

4.8 ETHICAL CONSIDERATION: The study is approved by the Institutional Ethics Committee Research Department, Santosh Deemed to be University, Ghaziabad - 201009, Delhi NCR. India.

4.9 SELECTION CRITERIA

- **Inclusion Criteria**
  1. Radiological staff have a diploma, a bachelor's degree, a Master's degree in radiology imaging techniques.
  2. Staff don't have any experience / fresher or new joining a hospital and in diagnostic center in radiology department.
  3. All male and female staff of various age groups are in the radiology department.
  4. Being clinically active and presently working as a radiographer and CT technologist.

- **Exclusion Criteria**
  1. Hospital and Diagnostic staff other than the radiology department.
  2. Hospitals and diagnostic centers aren't accredited by NABH.

4.10 ASSUMPTIONS: The study assumed that:

1. CT technologists have good knowledge about CT exposure parameters as compared to radiographers.
2. Post-graduation, radiographers or CT technologists have good knowledge about CT exposure parameters.

4.11 GAP ANALYSIS:

1. The sample size was small.
2. The application of questionnaires with questions that were not created with radiology staff training in mind.
3. Time limitations affect the answers and the opinion of the participants.

DATA ANALYSIS

A systematic questionnaire was used to gather data from a specific sample of respondents, and for data analysis, a quantitative research methodology was used. Data was obtained by using descriptive statistics. The acquired data was entered into a Microsoft Excel spreadsheet and subjected to analysis using the S-Test and the Descriptive Statistical Method.

The methods applied by the researchers encompassed T-test analysis, frequency distribution analysis, and descriptive statistics. The use of descriptive statistics was made for summarizing the characteristics of the data sets, and frequency distribution analysis facilitated the presentation of frequency counts to convey information in a straightforward manner.

The goal of the current study was to evaluate the understanding of the knowledge and awareness about CT exposure parameters of CT Technologist and Radiographers. The study's data were gathered online and were analyzed and is presented in two sections.

1. Analysis of demographic data of sample subjects. Demographic variables were initially organized using MS Excel, and frequency distribution was established.

2. Analysis of knowledge data. In order to examine the information and compute key statistics such as mean and standard deviation, SPSS software played a pivotal role in this research.

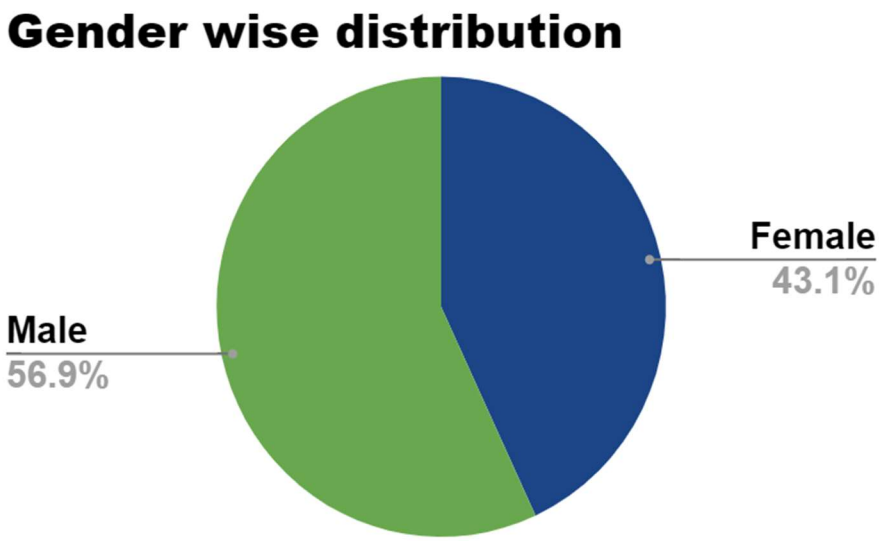
CHAPTER – 5

RESULT

RESULTS

The study helps to evaluate the knowledge and awareness of Radiological staff (CT Technologist and Radiographers) about CT exposure parameters in different hospitals and Diagnostic centers in Delhi-NCR. A close ended survey was distributed online using a Google form to CT technologist and Radiographers engaged in different hospitals and Diagnostic centers of Delhi-NCR. All the respondents completed every question in the survey.

There was total 246 respondents in this study. The survey had a slightly higher representation of males 140 (56.9%) compared to females 106 (43.1%) as shown in graph 1.



Graph 1: Gender wise distribution of Radiological staff.

Table 1: shows the responses of Socio-Demographic and occupational data of Radiological Staff.

Sr. No.	Parameter	Response	N	%
1.	Age	20-30 years	143	58.1
		31-40 years	74	30.1
		41-50 years	21	8.5
		51- above	8	3.3

2.	**Gender**	Female	106	43.1
		Male	140	56.9
3.	**Qualification**	Bachelor's degree	113	45.9
		Diploma	75	30.5
		Master degree	39	15.9
		Other's	19	7.7
4.	**Occupation**	CT Technologist	123	50.0
		Radiographer	123	50.0
5.	**Work experience in CT**	0-3 Years	95	38.6
		10 above	33	13.4
		4-6 years	68	27.6
		7-9 years	50	20.3
6.	**CT Scan protocol decision taken**	Application specialist	6	2.4
		Physicist	2	.8
		Radiologist	70	28.5
		Technologist	168	68.3
7.	**Confidence in altering protocol**	Less confident	43	17.5
		Moderately confident	81	32.9
		Not confident	21	8.5
		Very confident	101	41.1
8.	**Allow to modify any CT protocol to reduce patient dose**	No	6	2.4
		Yes	240	97.6
9.	**Attended any specialized CT training course**	No	191	77.6
		Yes	55	22.4
10.	**Workload in workspace**	Extremely heavy	56	22.8
		Heavy	87	35.4
		Moderate	75	30.5
		Sedentary	28	11.4

According to **Table 1** shows that there were 143 (58.1%) of respondents were between 20-30 years old, forming the majority, 74 (30.1%) were between 31-40 years old, only 21 (8.5%) were in the 41-50 age group, and 8 (3.3%) were 51 years or above.

The largest group 113 (45.9%) held a bachelor's degree followed by 75 (30.5%) who had a diploma, 39 (15.9%) who possessed a master's degree, and 19 (7.7%) who held other qualifications. The participants were divided equally between CT technologists (50%) and radiographers (50%).

Participants with 95 (38.6%) have 0-3 years of experience in CT, representing the largest group, followed by 68 (27.6%) had 4-6 years of experience, 50 (20.3%) had 7-9 years of experience, and 33 (13.4%) had 10 or more years of experience.

Technologists 168 (68.3%) were mostly responsible for deciding CT scan protocols, and Radiologists 70 (28.5%) also played a role in protocol decisions. Application specialists 6 (2.4%) and physicists 2 (0.8%) had minimal involvement.

101 (41.1%) were very confident in altering protocols, 81 (32.9%) were moderately confident, 43 (17.5%) were less confident, 21 (8.5%) were not confident.

An overwhelming majority 240 (97.6%) were allowed to modify CT protocols to reduce patient dose. Only 6 (2.4%) were not allowed to modify protocols. Similarly, 55 (22.4%) had attended specialized CT training courses and 191 (77.6%) had not attended such courses.

87 (35.4%) reported a heavy workload, 75 (30.5%) had a moderate workload, 56 (22.8%) had an extremely heavy workload, 28 (11.4%) had a sedentary workload.

Table 2: shows the Frequency distribution of Responses of the knowledge of Radiological staff about CT exposure parameters.

Sr. No.	Parameter	Response	N	%
1.	Reducing kVp would reduce the contrast resolution	No	5	2.0
		Yes	241	98.0
2.	Kvp should increase with patients having metallic implants	No	29	11.8
		Yes	217	88.2
3.	Reducing kVp from 120 to 100 for angiographic procedure reduces the image contrast	No	161	65.4
		Yes	85	34.6
4.	Increasing kVp by 50% is equivalent to doubling the mAs	No	162	65.9
		Yes	84	34.1
5.	Doubling the mAs doubling the dose	No	3	1.2
		Yes	243	98.8
6.	Reducing the tube current by 50% increases the noise two-fold	No	69	28.0
		Yes	177	72.0
7.	mAs should be increased as the body part thickness increases	No	8	3.3
		Yes	238	96.7
8.	Decreasing the pitch degrades image quality	No	162	65.9
		Yes	84	34.1
9.	Increasing the pitch decrease the dose	No	18	7.3
		Yes	228	92.7
10.	A low pitch technique is helpful in detecting a small lesion	No	110	44.7
		Yes	136	55.3

11.	**Can you reduce radiation dose in spiral CT by increasing pitch**	No	24	9.8
		Yes	222	90.2
12.	**Reducing the mAs reduces the noise**	No	181	73.6
		Yes	65	26.4
13.	**Increasing slice thickness increasing noise**	No	6	2.4
		Yes	240	97.6
14.	**Readers can tolerate less noise with obese patients**	No	232	94.3
		Yes	14	5.7
15.	**A smoothing reconstruction kernel, increases the visualization of noise**	No	186	75.6
		Yes	60	24.4
16.	**Increase the slice thickness, decrease the patient dose**	No	14	5.7
		Yes	232	94.3
17.	**Decreasing the slice thickness will decrease the scan time**	No	183	74.4
		Yes	63	25.6
18.	**ATCM (Automatic tube current modulation) is affected by improper patient positioning**	No	12	4.9
		Yes	234	95.1
19.	**ATCM (Automatic tube current modulation) decreases patient dose**	No	76	30.9
		Yes	170	69.1
20.	**ATCM (Automatic tube current modulation) increases the dose to obese patients**	No	181	73.6
		Yes	65	26.4
21.	**ATCM (Automatic tube current modulation) increases the patient dose in the pelvic region**	No	206	83.7
		Yes	40	16.3
22.	**ATCM (Automatic tube current modulation) should not be used in the presence of metallic implants**	No	87	35.4
		Yes	159	64.6

23.	**Routine CT scanning parameters (kVp, mAs, slice thickness, pitch, etc.) should be changed according to patient size, anatomical region, study indication, patient age**	No	3	1.2
		Yes	243	98.8

According to **Table 2:** There was total 246 respondents in this study. The participants further asked if reducing **kVp** would reduce the contrast resolution 241 (98.0%) participants responded correctly. The participants were asked if Kvp should increase with patients having metallic implants 217 (88.2%) answered correctly. When asked Reducing kVp from 120 to 100 for angiographic procedure reduces the image contrast 85 (34.6%) answered incorrectly. Participants asked Increasing kVp by 50% is equivalent to doubling the mAs 84 (34.1%) answered incorrectly.

A question on **mAs** was answered correctly by 243 (98.8%) the participants on Doubling the mAs doubling the dose. Participants asked Reducing the tube current by 50% increases the noise two-fold 177 (72.0%) answered correctly. For mAs should be increased as the body part thickness increases 238 (96.7%) answered correctly.

The participants knowledge about **pitch** and its effect on dose and image quality. In total 84 (34.1%) answered incorrectly that Decreasing the pitch degrades image quality. 228 (92.7%) answered correctly that Increasing the pitch decrease the dose. For A low pitch technique is helpful in detecting a small lesion 136 (55.3%) answered correctly. For Can you reduce radiation dose in spiral CT by increasing pitch 222 (90.2%) answered correctly.

The participants knowledge about **noise** is that the participants 65 (26.4%) answered incorrectly for Reducing the mAs reduces the noise. Participants asked Increasing slice thickness increasing noise 240 (97.6%) answered correctly. For Readers can tolerate less noise with obese patients 14 (5.7%) answered incorrectly. For A smoothing reconstruction kernel, increases the visualization of noise 60 (24.4%) answered incorrectly.

The participants further asked questions on **slice thickness**, 232 (94.3%) answered correctly for Increase the slice thickness, decrease the patient dose. For Decreasing the slice thickness will decrease the scan time 63 (25.6%) answered incorrectly.

The participants' knowledge about **ATCM** was also queried. When asked ATCM is affected by improper patient positioning 234 (95.1%) answered correctly. For ATCM decreases patient dose 170 (69.1%) answered correctly. Participants asked for ATCM increases the dose to obese patients 65 (26.4%) answered incorrectly. For ATCM increases the patient dose in the pelvic region 40 (16.3%) answered incorrectly. 159 (64.6%) answered incorrectly when asked ATCM should not be used in the presence of metallic implants.

Participants asked about Routine CT scanning parameters (kVp, mAs, slice thickness, pitch, etc.) should be changed according to patient size, anatomical region, study indication, patient age 243 (98.8%) answered correctly.

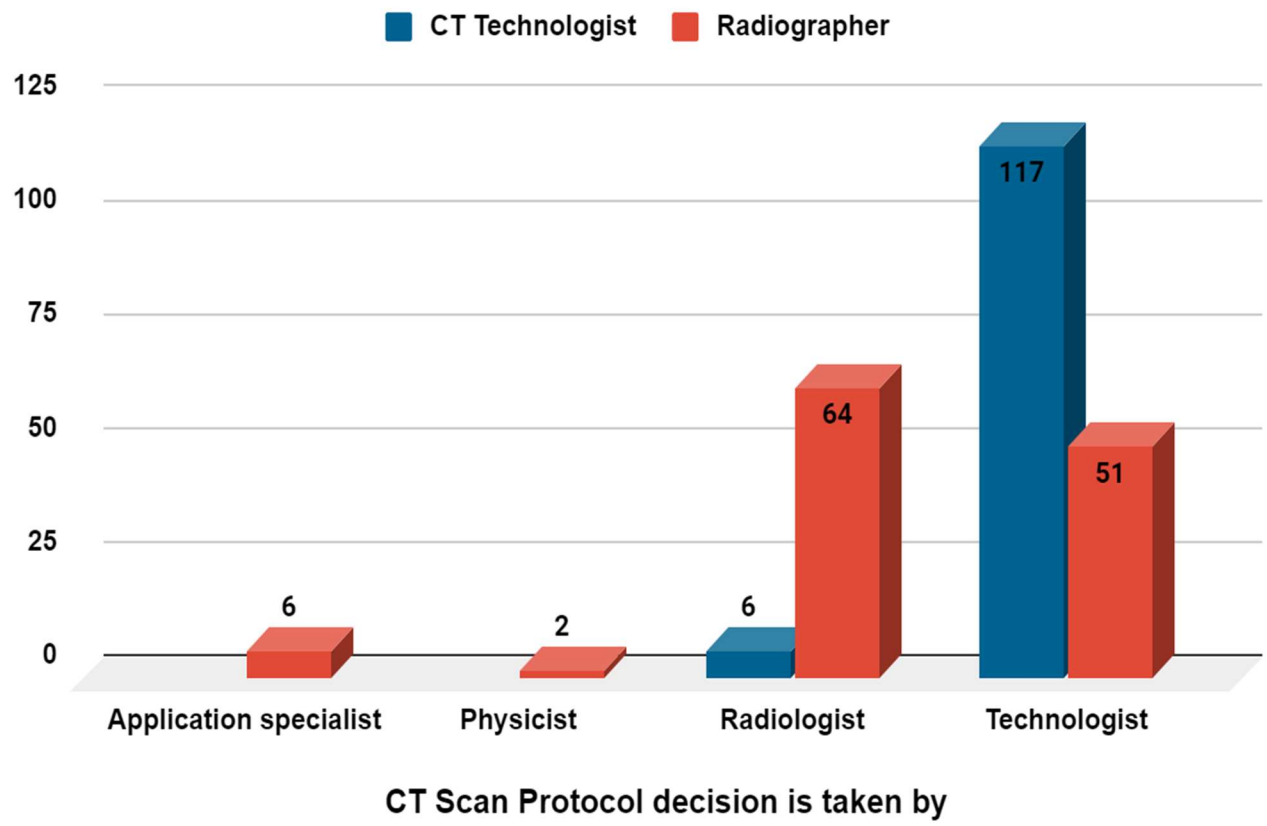
❖ Demographic and occupational characteristics of CT Technologist and Radiographer

Table 3: shows the demographic distribution of data according to knowledge of CT Technologist and Radiographer.

Parameter	Response	Occupation				p-value
		CT Technologist	% of CT Technologist	Radiographers	% of Radiographers	
Age	20-30 years	45	36.6%	98	79.7%	<0.000
	31-40 years	54	43.9%	20	46.3%	<0.000
	41-50 years	17	13.8%	4	3.2%	0.002
	51- above	7	5.7%	1	0.8%	0.030
Gender	Female	45	36.6%	61	49.6%	0.039
	Male	78	63.4%	62	50.4%	
Qualification	Bachelor's degree	54	43.9%	59	48.0%	0.522

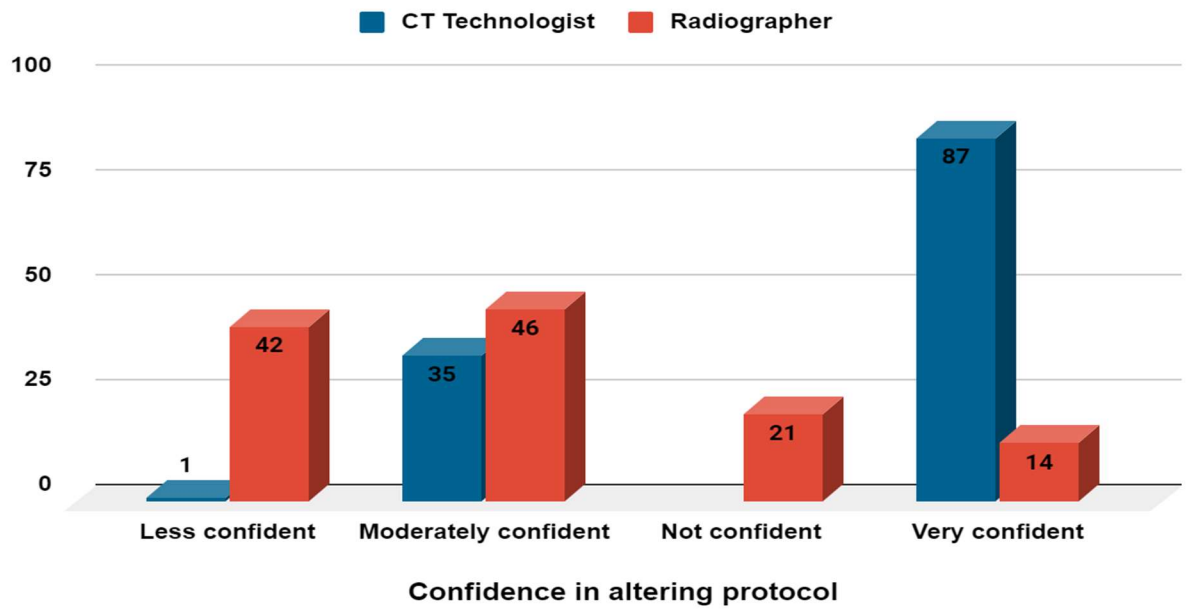
	Diploma	26	21.1%	49	39.8%	0.001
	Master degree	27	22.0%	12	9.8%	0.008
	Other's	16	13.0%	3	2.4%	0.001
Work experience in CT	0-3 Years	14	11.4%	81	65.8%	<0.000
	10 above	28	22.7%	5	4.1%	<0.000
	4-6 years	37	30.1%	31	25.2%	0.389
	7-9 years	44	35.8%	6	4.9%	<0.000
CT Scan protocol decision is taken by	Application Specialist	0	0.0%	6	4.9%	0.013
	Physicist	0	0.0%	2	1.6%	0.155
	Radiologist	6	4.9%	64	52.0%	<0.000
	Technologist	117	95.1%	51	41.5%	<0.000
Confidence in altering protocol	Less confident	1	0.8%	42	34.1%	<0.000
	Moderately confident	35	28.5%	46	37.4%	0.136
	Not confident	0	0.0%	21	17.1%	<0.000
	Very confident	87	70.7%	14	11.4%	<0.000
Allow to modify any CT protocol to reduce patient dose	No	3	2.4%	3	2.4%	1.000
	Yes	120	97.6%	120	97.6%	
Attended any specialized CT training course	No	95	77.2%	96	78.0%	0.880
	Yes	28	22.85	27	22.0%	
Work load in your work space	Extremely heavy	56	45.5%	0	0.0%	<0.000
	Heavy	53	43.1%	34	27.6%	0.011
	Moderate	8	6.5%	67	54.5%	<0.000
	Sedentary	6	4.9%	22	17.9%	0.001

According to **Table 3.** shows that in questionnaire participants were questioned about the protocol decision taken during CT scan test, CT technologist stated that 95.1% decision were taken by technologist while the rest of the CT technologist stated that 4.9% decision were taken by Radiologist. On the other hand, Radiographer stated that 41.5% decision were taken by technologist while 52.0% were taken by radiologist, 4.9% were taken by application specialist and 1.6% decision were taken by physicist as illustrated in Graph 3.



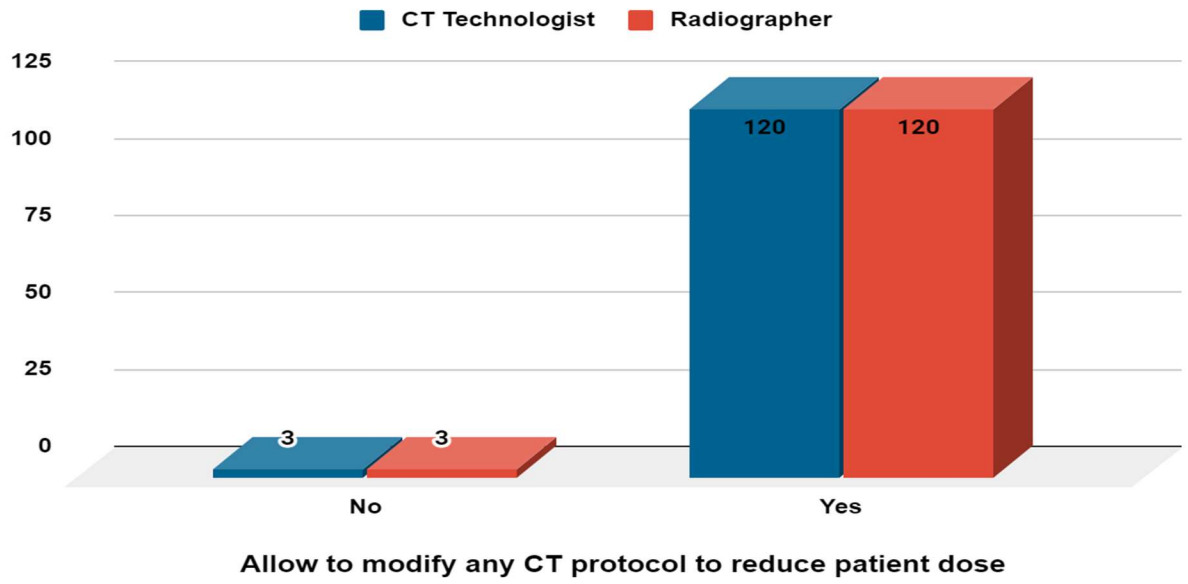
Graph 3: shows the comparison of CT Scan protocol decision is taken by of the participants (CT Technologist and Radiographer)

CT technologists had a significantly higher proportion reporting in very high confidence in altering protocols with 70.7%, while radiographers had a higher proportion reporting in less and moderately confidence with 34.1% and 37.4% as illustrated in graph 3.

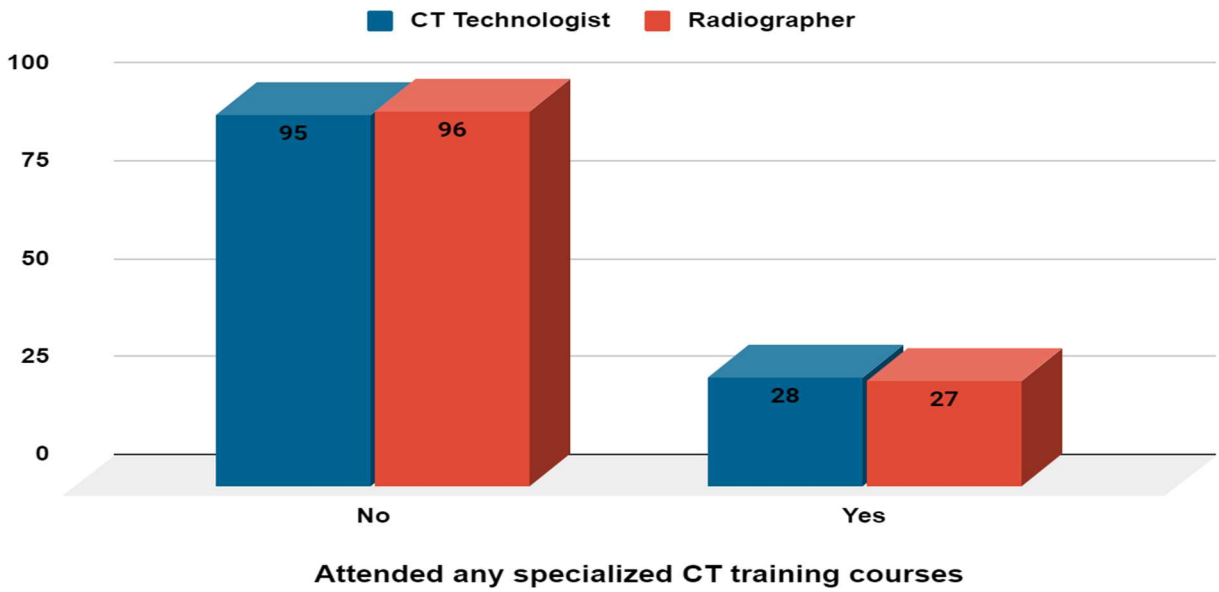


Graph 3: shows the comparison of confidence in altering protocol of the participants (CT Technologist and Radiographer)

The two groups did not significantly differ from one another in terms of attending specialized CT training courses and allow to modify any CT protocol to reduce patient dose as illustrated in graph 3.

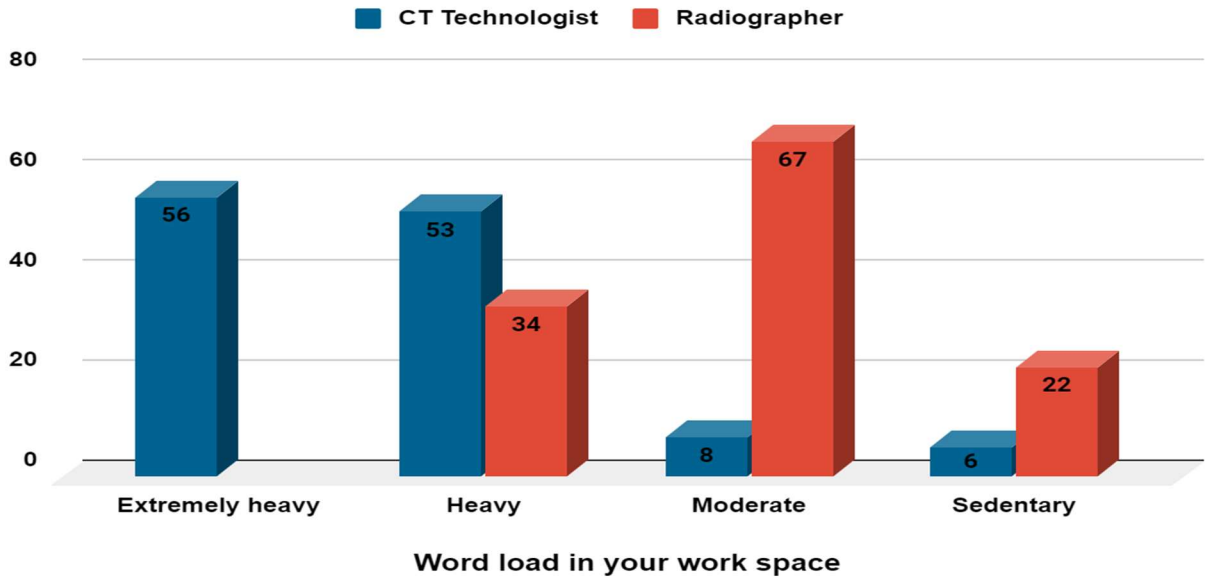


Graph 3: shows the comparison of allow to modify any CT protocol to reduce patient dose of the participants (CT Technologist and Radiographer).



Graph 3: shows the comparison of attended any specialized CT training courses of the participants (CT Technologist and Radiographer).

CT Technologist had a significantly higher proportion reporting extremely heavy and heavy workloads with 45.5% and 43.1%, while Radiographers had a higher proportion reporting moderate and sedentary workloads with 54.5% and 17.9% as illustrated in graph 3.

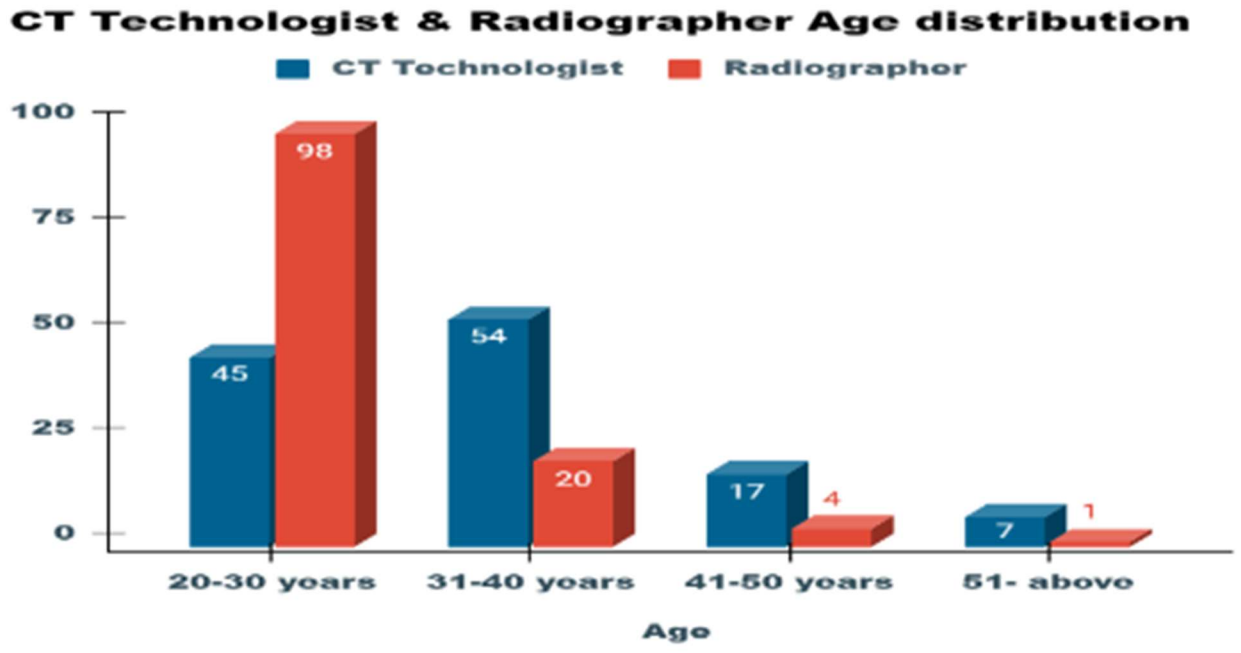


Graph 3: shows the comparison of work load in your work space of the participants (CT Technologist and Radiographer).

- **Relationship between CT Technologist and Radiographer according to Age**

Table 4: shows the age of the participants (CT Technologist and Radiographer)

Age * Occupation Crosstabulation					
			Occupation		Total
			CT Technologist	Radiographer	
Age	20-30 years	Count	45	98	143
		% within Occupation	36.6%	79.7%	58.1%
	31-40 years	Count	54	20	74
		% within Occupation	43.9%	46.3%	30.1%
	41-50 years	Count	17	4	21
		% within Occupation	13.8%	3.2%	8.5%
	51- above	Count	7	1	8
		% within Occupation	5.7%	0.8%	3.3%
Total		Count	123	123	246
		% within Occupation	100.0%	100.0%	100.0%



Graph 4: shows the age of the participants (CT Technologist and Radiographer)

According to Table 4:

Age Distribution of CT Technologist: There were 123 participants for CT technologist populations. Maximum number of CT technologist population are from age group of 31-40 years with 43.9 %, 36.6 % 0f population are from 20-30 years age group, 13.8 % are from 41-50 years and only 5.7% are from age group of 51- above.

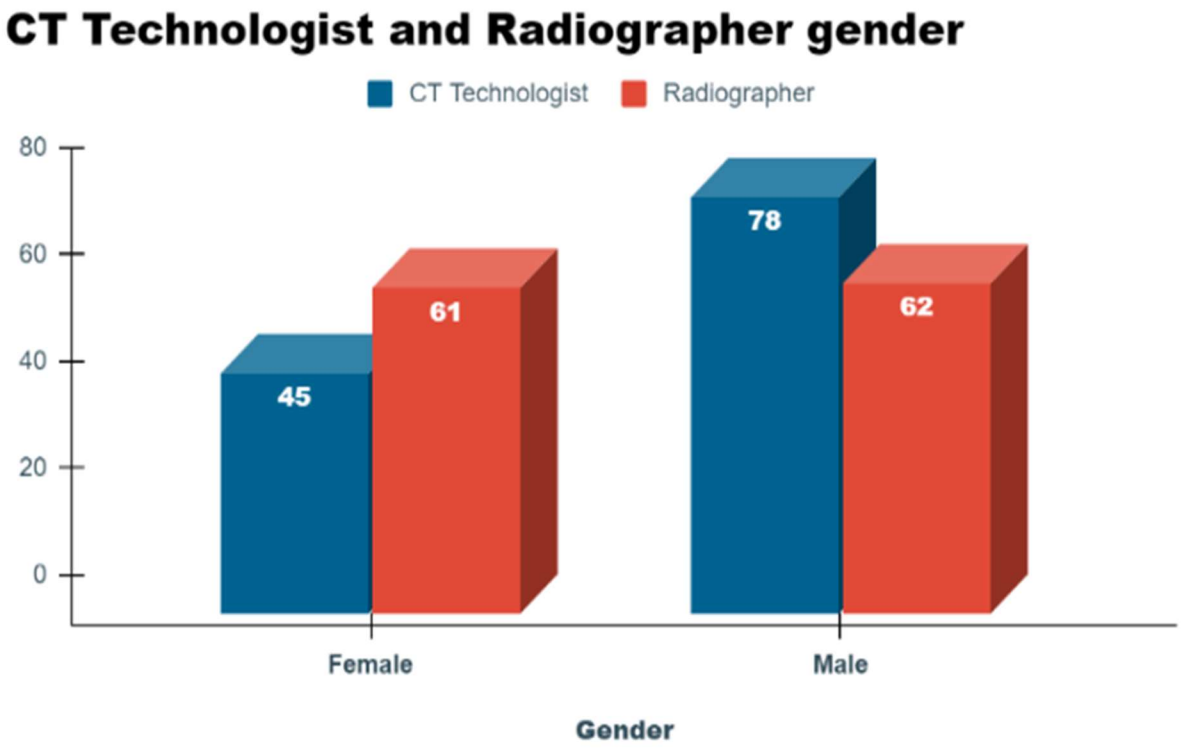
Age Distribution of Radiographers: There were 123 participants for CT technologist populations. Maximum number of Radiographers population are from age group of 20-30 years with 79.7 %, 16.3 % 0f population are from 31-40 years age group, 3.2 % are from 41-50 years and only 0.8 % are from age group of 51- above.

There were significant differences in the age distributions between the two groups, with a higher proportion of radiographers falling into the younger age groups (20-30 and 31-40 years) compared to CT technologists as shown in **graph 4**.

- **Relationship between CT Technologist and Radiographer according to Gender**

Table 5: shows the gender of the participants (CT Technologist and Radiographer)

Gender * Occupation Crosstabulation					
			Occupation		Total
			CT Technologist	Radiographer	
Gender	Male	Count	78	62	140
		% within Occupation	63.4%	50.4%	56.9%
	Female	Count	45	61	106
		% within Occupation	36.6%	49.6%	43.1%
Total		Count	123	123	246
		% within Occupation	100.0%	100.0%	100.0%



Graph 5: shows the gender of the participants (CT Technologist and Radiographer)

According to Table 5:

Gender distribution of CT Technologist: There were 123 participants for CT Technologist populations. Out of which 63.4 % were male and 36.6 % were female.

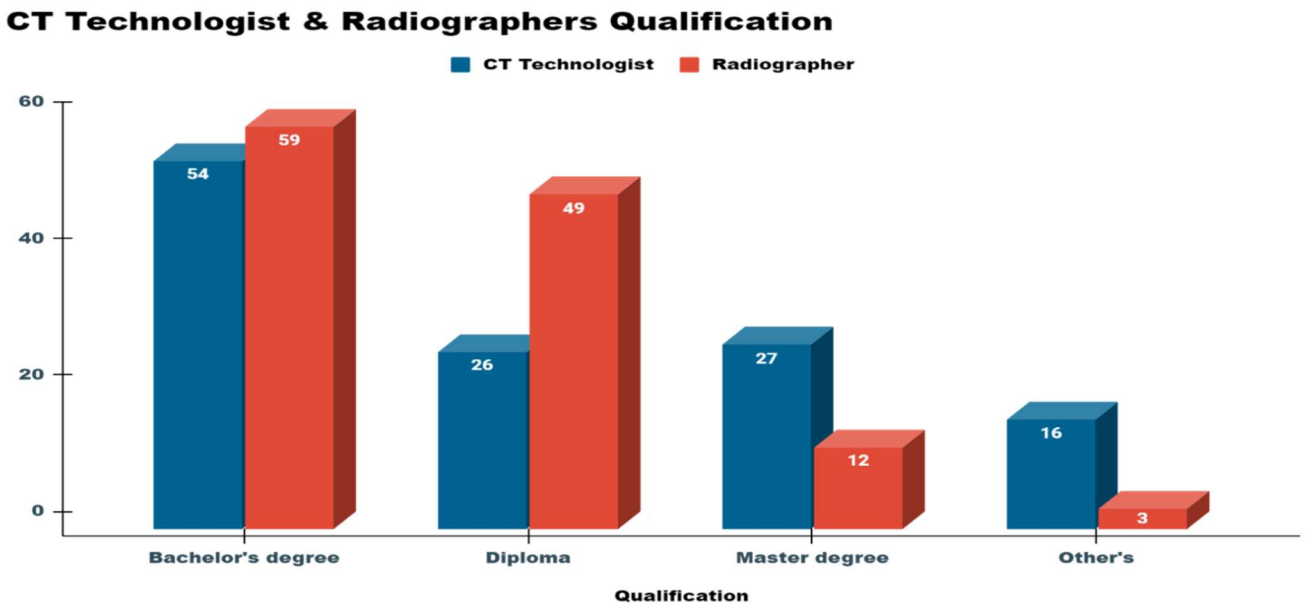
Gender distribution of Radiographers: There were 123 participants for Radiographer populations. Out of which 50.4 % were male and 49.6 % were female.

Among radiographers the percentage of females was considerably lower than that of CT technologists. The proportion of CT technologist male were higher than the female as shown in **graph 5**.

- **Relationship between CT Technologist and Radiographer according to Educational Qualification**

Table 6: shows the educational qualification of the participants (CT Technologist and Radiographer)

Educational Qualification * Occupation Crosstabulation					
			Occupation		Total
			CT Technologist	Radiographer	
Educational Qualification	Bachelor's degree	Count	54	59	113
		% within Occupation	43.9%	48.0%	45.9%
	Diploma	Count	26	49	75
		% within Occupation	21.1%	39.8%	30.5%
	Master degree	Count	27	12	39
		% within Occupation	22.0%	9.8%	15.9%
	Other's	Count	16	3	19
		% within Occupation	13.0%	2.4%	7.7%
Total		Count	123	123	246
		% within Occupation	100.0%	100.0%	100.0%



Graph 6: shows the educational qualification of the participants (CT Technologist and Radiographer.

According to Table 6:

Educational Qualification distribution of CT Technologist: There were 123 participants for CT Technologist populations. Out of which maximum number of CT technologist population have Bachelor's degree with 43.9 %, 22.0 % 0f population have master's degree, 21.1 % have diploma and only 13.0 % have other's qualification.

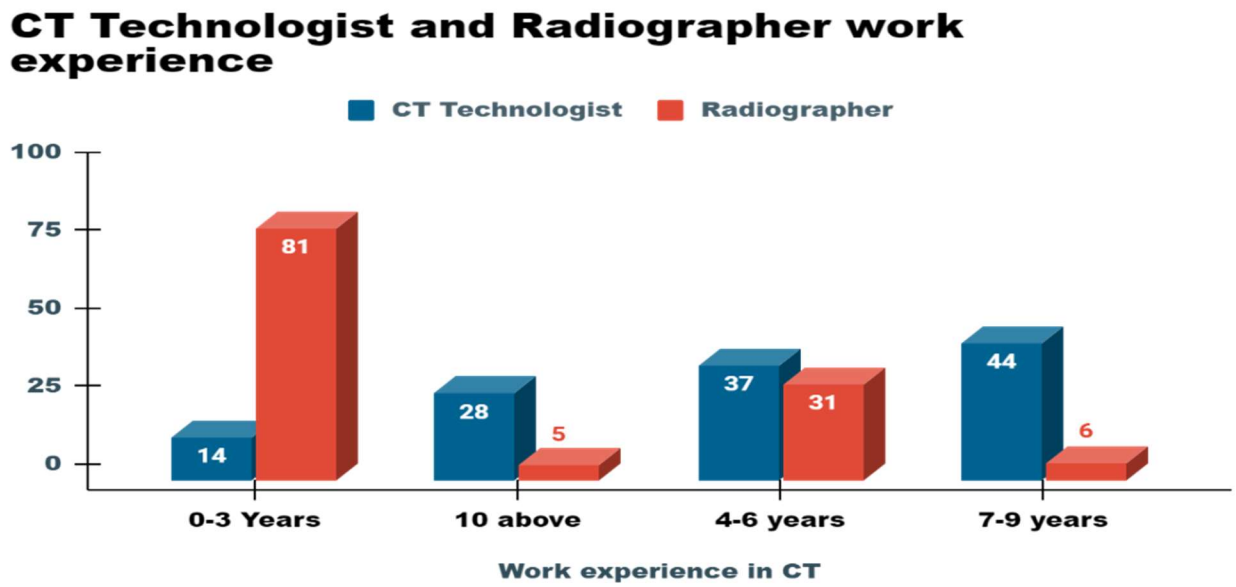
Educational Qualification distribution of Radiographers: There were 123 participants for Radiographers populations. Out of which maximum number of CT technologist population have Bachelor's degree with 48.0 %, 9.8 % 0f population have master's degree, 39.8 % have diploma and only 2.4 % have other's qualification.

There were significant differences in educational qualifications between the two groups. Radiographers having maximum Diploma and Bachelor's degree but minimum master's and other's degree while CT Technologist population having maximum master's degree and other's qualification compared to radiographers than Bachelor's and diploma as shown in **graph 6**.

- **Relationship between CT Technologist and Radiographer according to Work Experience**

Table 7: shows the work experience of the participants (CT Technologist and Radiographer)

Work Experience in CT * Occupation Crosstabulation					
			Occupation		Total
			CT Technologist	Radiographer	
Work Experience in CT	0-3 Years	Count	14	81	95
		% within Occupation	11.4%	65.8%	38.6%
	4-6 years	Count	37	31	68
		% within Occupation	30.1%	25.2%	27.6%
	7-9 years	Count	44	6	50
		% within Occupation	35.8%	4.9%	20.3%
	10 above	Count	28	5	33
		% within Occupation	22.7%	4.1%	13.4%
Total		Count	123	123	246
		% within Occupation	100.0%	100.0%	100.0%



Graph 7: shows the work experience of the participants (CT Technologist and Radiographer)

According to Table 7:

Work Experience in CT distribution of CT Technologist: There were 123 total participants of CT Technologists in which maximum number of CT Technologist have 7-9 years of experiences with 35.8 % while CT Technologist have 4-6 years of experiences with 30.1 %, 10 above years of experience with 22.7 % and only 11.4 % have 0-3 years of CT experiences.

Work Experience in CT distribution of Radiographer: There were 123 total participants of Radiographer in which maximum number of Radiographers have 0-3 years of experiences with 65.8 % while CT Technologist have 4-6 years of experiences with 25.2 %, 7-9 years of experience with 4.9 % and only 4.1 % have 10 above years of work experience in CT scan.

Significant differences are observed in the distribution of work experience in CT between the two groups. Radiographers had a higher proportion with 0-3 years and 4-6 years of experience, while CT technologists had a higher proportion with 7-9 years of experience and 10 above experience is shown in **graph 7**.

❖ CT Parameters

Table 8: shows total knowledge score of radiographers and CT technologist about different CT parameters (Mean ± SD)

Parameter	Occupation	Mean Score	SD	p-value
Reducing kVp would reduce the contrast resolution	Radiographer	0.96	0.198	0.025
	CT Technologists	1.00	0.000	
Kvp should increase with patients having metallic implants	Radiographer	0.87	0.338	0.555
	CT Technologists	0.89	0.309	
Reducing kVp from 120 to 100 for angiographic procedure reduces the image contrast	Radiographer	0.58	0.496	0.011
	CT Technologists	0.73	0.445	
Increasing kVp by 50% is equivalent to doubling the mAs	Radiographer	0.59	0.495	0.015
	CT Technologists	0.73	0.445	
Doubling the mAs doubling the dose	Radiographer	0.98	0.155	0.083
	CT Technologists	1.00	0.000	
Reducing the tube current by 50% increases the 0ise two-fold	Radiographer	0.74	0.441	0.480
	CT Technologists	0.70	0.460	
mAs should be increased as the body part thickness increases	Radiographer	0.96	0.198	0.474
	CT Technologists	0.98	0.155	
Decreasing the pitch degrades image quality	Radiographer	0.58	0.496	0.007
	CT Technologists	0.74	0.441	
Increasing the pitch decrease the dose	Radiographer	0.92	0.274	0.626
	CT Technologists	0.93	0.248	
A low pitch technique is helpful in detecting a small lesion	Radiographer	0.52	0.502	0.307
	CT Technologists	0.59	0.495	

Can you reduce radiation dose in spiral CT by increasing pitch	Radiographer	0.86	0.347	0.032
	CT Technologists	0.94	0.233	
Reducing the mAs reduces the 1ise	Radiographer	0.68	0.467	0.061
	CT Technologists	0.79	0.410	
Increasing slice thickness increasing 0ise	Radiographer	0.97	0.178	0.411
	CT Technologists	0.98	0.127	
Readers can tolerate less 1ise with obese patients	Radiographer	0.91	0.287	0.028
	CT Technologists	0.98	0.155	
A smoothing reconstruction kernel, increases the visualization of 1ise	Radiographer	0.72	0.453	0.139
	CT Technologists	0.80	0.404	
Increase the slice thickness, decrease the patient dose	Radiographer	0.93	0.248	0.584
	CT Technologists	0.95	0.216	
Decreasing the slice thickness will decrease the scan time	Radiographer	0.63	0.484	0.000
	CT Technologists	0.85	0.355	
ATCM (Automatic tube current modulation) is affected by improper patient positioning	Radiographer	0.93	0.261	0.077
	CT Technologists	0.98	0.155	
ATCM (Automatic tube current modulation) decreases patient dose	Radiographer	0.67	0.470	0.583
	CT Technologists	0.71	0.457	
ATCM (Automatic tube current modulation) increases the dose to obese patients	Radiographer	0.70	0.460	0.195
	CT Technologists	0.77	0.421	
ATCM (Automatic tube current modulation) increases the patient dose in the pelvic region	Radiographer	0.80	0.398	0.168
	CT Technologists	0.87	0.338	
ATCM (Automatic tube current modulation) should 1t be used in the presence of metallic implants	Radiographer	0.36	0.481	0.894
	CT Technologists	0.35	0.479	

Routine CT scanning parameters (kVp, mAs, slice thickness, pitch, etc.) should be changed according to patient size, anatomical region, study indication, patient age	Radiographer	0.98	0.155	0.083
	CT Technologists	1.00	0.000	
Total knowledge of CT parameters	Radiographer	0.77	0.417	0.205
	CT Technologist	0.83	0.369	

0 (incorrect) or 1 (correct)

According to **Table 8**. shows that the total number of responses of CT Technologist and Radiographer are 123 and 123. The knowledge of CT Technologist and Radiographer responded the correct answer for **kVp** Q1. Reducing kVp would reduce the contrast resolution are 100% and 95.9%, For Q2. Kvp should increase with patients having metallic implants the correct responses for CT Technologist and Radiographer are 89.4% and 87.0%, For Q3. Reducing kVp from 120 to 100 for angiographic procedure reduces the image contrast the correct responses for CT Technologist and Radiographer are 73.2% and 87.7%, For Q4. Increasing kVp by 50% is equivalent to doubling the mAs the correct responses for CT Technologist and Radiographer are 73.2% and 58.5%.

For **mAs** Q5. Doubling the mAs doubling the dose the correct responses for CT Technologist and Radiographer are 100% and 97.6%, For Q6. Reducing the tube current by 50% increases the noise two-fold the correct responses for CT Technologist and Radiographer are 69.9% and 74.0%, For Q7. mAs should be increased as the body part thickness increases the correct responses for CT Technologist and Radiographer are 97.6% and 95.9%.

For **pitch** Q8. Decreasing the pitch degrades image quality the correct responses for CT Technologist and Radiographer are 74.0% and 57.7%, For Q9. Increasing the pitch decrease the dose the correct responses for CT Technologist and Radiographer are 93.5% and 91.9%, For Q10. A low pitch technique is helpful in detecting a small lesion the correct responses for CT Technologist and Radiographer are 58.5% and 52.0%, For Q11. Can you reduce radiation dose in spiral CT by increasing pitch the correct responses for CT Technologist and Radiographer are 94.3% and 86.2%.

For **noise** Q12. Reducing the mAs reduces the noise the correct responses for CT Technologist and Radiographer are 78.9% and 68.3%, For Q13.Increasing slice thickness increasing noise the correct responses for CT Technologist and Radiographer are 98.4% and 96.7%, For Q14. Readers can tolerate less noise with obese patients the correct responses for CT Technologist and Radiographer are 97.6% and 91.1%, For Q15. A smoothing reconstruction kernel, increases the visualization of noise the correct responses for CT Technologist and Radiographer are 79.7% and 71.5%.

For **slice thickness** Q16. Increases the slice thickness, decrease the patient dose the correct responses for CT Technologist and Radiographer are 95.1% and 93.5%, For Q17. Decreasing the slice thickness will decrease the scan time the correct responses for CT Technologist and Radiographer are 85.4% and 63.4%.

For **ATCM** Q18. ATCM (Automatic tube current modulation) is affected by improper patient positioning the correct responses for CT Technologist and Radiographer are 97.6% and 92.7%, For Q19. ATCM (Automatic tube current modulation) decreases patient dose the correct responses for CT Technologist and Radiographer are 70.7% and 67.5%, For Q20. ATCM (Automatic tube current modulation) decreases patient dose the correct responses for CT Technologist and Radiographer are 77.2% and 69.9%, %, For Q21. ATCM (Automatic tube current modulation) increases the patient dose in the pelvic region the correct responses for CT Technologist and Radiographer are 87.0% and 80.5%, For Q22. ATCM (Automatic tube current modulation) should not be used in the presence of metallic implants the correct responses for CT Technologist and Radiographer are 35.0% and 35.8%.

For Q23.Routine CT scanning parameters (kVp, mAs, slice thickness, pitch, etc.) should be changed according to patient size, anatomical region, study indication, patient age the correct responses for CT Technologist and Radiographer are 100% and 97.6%.

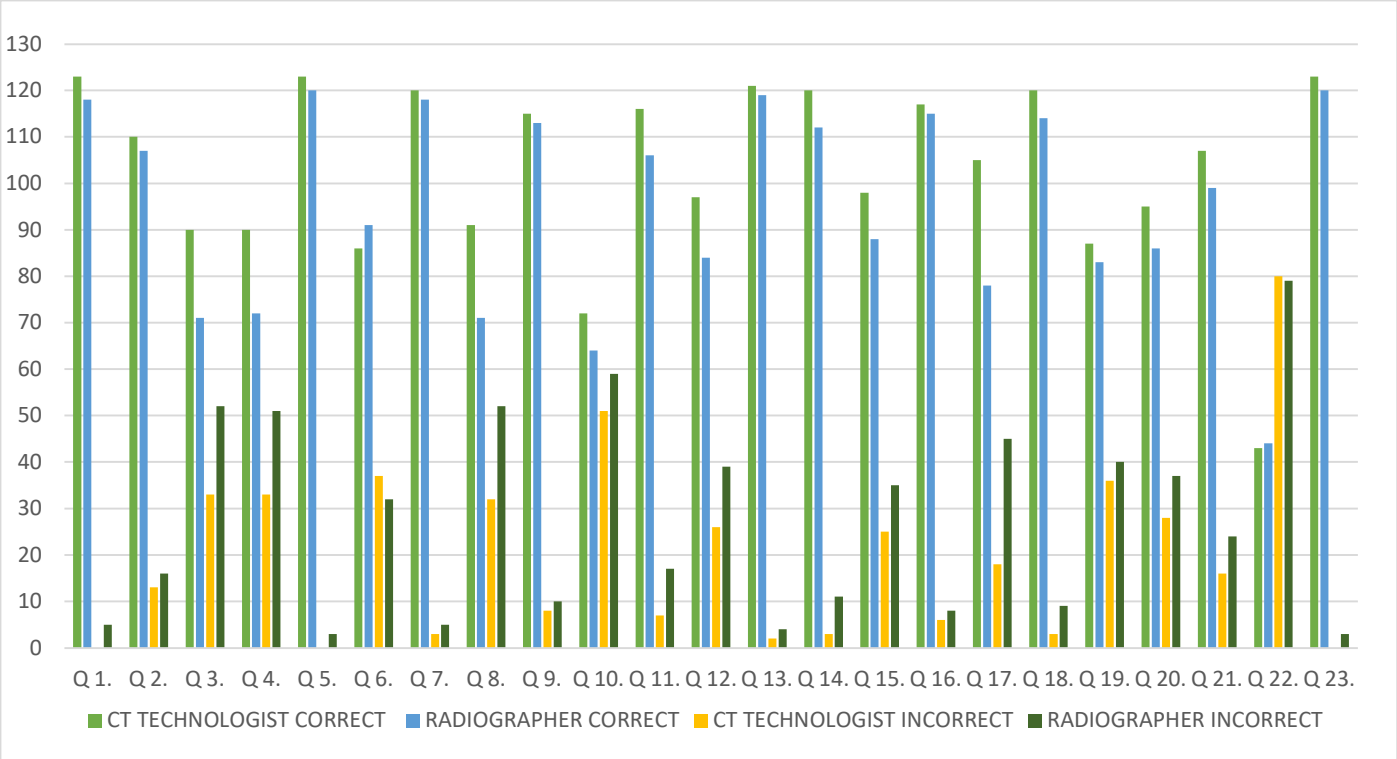
As shown in Table 8, the total knowledge of CT technologist and Radiographers about CT parameters were 0.83 ± 0.369 and 0.77 ± 0.417 respectively. **Therefore, this difference did not reach statistical significance. ($p > 0.05$).**

According to independent T- test, there was a significant difference between the response of Radiographers and CT Technologists for the questions on Reducing kVp would reduce the

contrast resolution, Reducing kVp from 120 to 100 for angiographic procedure reduces the image contrast, Increasing kVp by 50% is equivalent to doubling the mAs, Decreasing the pitch degrades image quality, Can you reduce radiation dose in spiral CT by increasing pitch, Readers can tolerate less noise with obese patients, Decreasing the slice thickness will decrease the scan time ($p < 0.05$).

There was no discernible difference in the answers of Radiologists and CT Technologists for the remaining questions ($p > 0.05$).

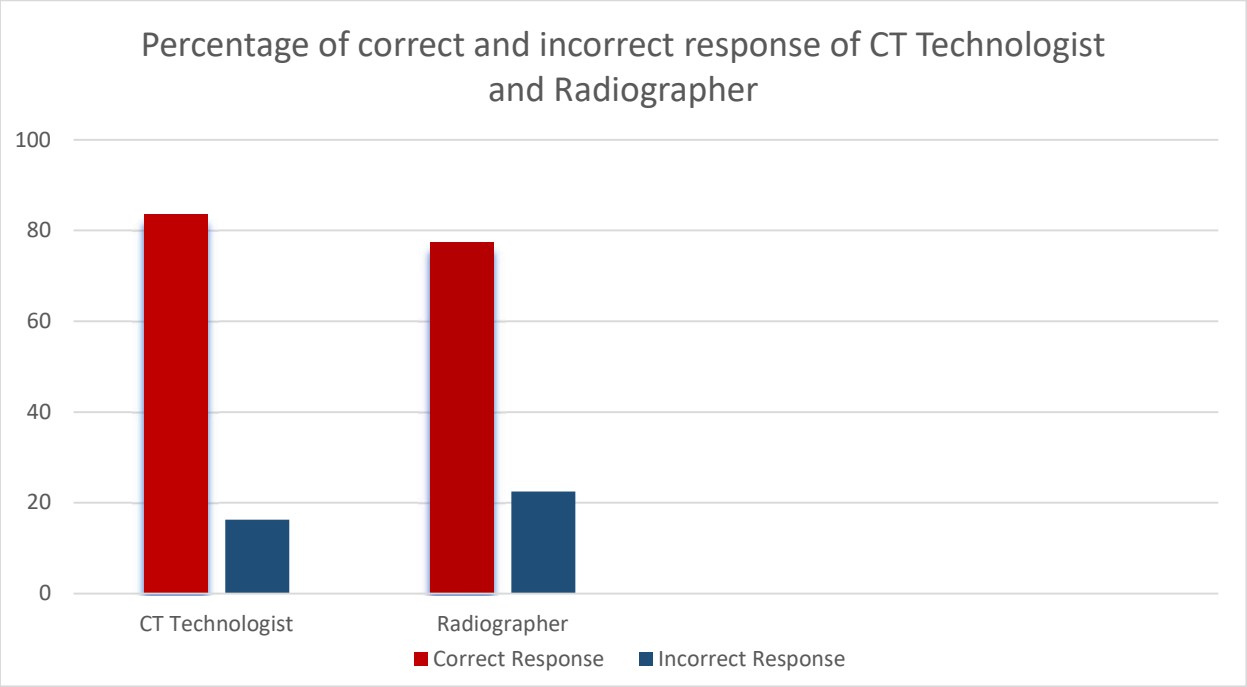
Responses of CT Technologist and Radiographer participants



Graph 8: shows comparison of total number of correct and incorrect answers of CT Technologist and Radiographers in CT scan

The responses show that these questions no.3, 4, 6, 8, 10, 19, 20 and 22 have low percentage of correct answer by CT technologist. The responses show that these questions no.3, 4, 6, 8, 10, 12, 15, 17, 19, 20 and 22 have low percentage of correct answer by Radiographer is shown in **graph 8**.

The responses show that these questions no.1, 5, 7, 13,14, 16, 18, 23 have high percentage of correct answer by CT technologist. The responses show that these questions no. 1, 5, 7, 13, 23 have high percentage of correct answer by Radiographer is shown in **graph 8**.



Graph 8: shows comparison of percentage of total number of correct and incorrect answers of CT Technologist and Radiographers in CT scan.

There were 2829 total responses of 23 questions of 123 participants for CT Technologist and same 2829 total responses of 23 questions of 123 for Radiographers. Responses were collected from the CT Technologist and Radiographer and specified under two categories based to the correct percentage and incorrect percentage which suggests that a large percentage of the questions had valid answers. The average percentage of correct responses of CT technologist are 2369 (83.74 %) and the average percentage of incorrect answer are 460 (16.26 %). The average percentage of correct responses of Radiographer are 2193 (77.52 %) and the average percentage of incorrect answer is 636 (22.48 %) shown in graph 8. This shows that Radiographer has less knowledge about CT exposure parameters than CT Technologist.

CHAPTER – 6

DISCUSSION

DISCUSSION

This study's objective was to assess the level of knowledge of CT technologists and Radiographer who worked in different hospitals and diagnostic centers in Delhi NCR. Evaluation of the Radiological staff knowledge will ensure the delivery of training objectives, filling of the gap between the theory and practice, and improvement in their knowledge. In addition, definition of any knowledge deficiencies will help the educational institute to design appropriate continuous education programs for the Radiological staff.

CT scan has become an intense imaging modality in diagnosing minor and major trauma, internal medical examination with excellent accuracy, and recent technological advancements such as iterative image reconstruction, multi-slice CT, dual-energy CT, and cone beam CT have increased its us. It has more significant impact of CT on rapid diagnosis and monitoring of disease processes has led to the expansion of its application [21]. On the other hand, CT is a significant source of radiation production and is associated with a considerably higher dose than other radiological procedures. Radiation exposure at high doses can produced harmful radiation hazards can result in gene mutation and cancer. Radiological staff must have accurate knowledge of CT scan exposure parameters to adjust the CT parameters in lowest possible dose according to patient age, size and shape but without compromising on good quality image.

DEMOGRAPHIC CHARACTERISTICS

In this study the sample size for CT Technologist and Radiographer were 123 and 123 respectively.

In previous study by Mohammad Rawashdeh et al…, shows that in sample size of 54, 57.4% Radiographers have sufficient knowledge regarding change parameters without degrading the image quality [6]. In current study in sample size of 123 CT Technologist, 70.7% CT Technologist were very confident in altering protocol while in sample size of 123 radiographers, 37.4 % Radiographers were moderately confident in altering protocol. In this CT Technologist shows more confident bur radiographers were less confident compared to previous study.

In previous study by Zahra Kazemi et al…, shows that 67 (71.3%) were females and 27 (28.7 %) were males out of 94 responses of the participants [9]. In current study 78 (63.4%) were male and

45 (36.6 %) were female CT Technologist out of 123 CT technologist participants and 62 (50.4 %) were male and 61 (49.6 %) were female Radiographers out of 123 Radiographers participants.

KNOWLEDGE REGARDING CT EXPOSURE PARAMETERS

The current study shows overall less knowledge in Radiographers parameters and more knowledge in CT Technologist participants about CT exposure parameters. The responses shows that Radiographers had answered overall 77.52 % of correct answer and 22.48 % of incorrect answer, which indicates that Radiographers have less knowledge about CT exposure parameters. On the other hand, the responses from CT Technologist shows that they had answered 83.74 % correctly while only 16.26 % had answered incorrectly, which indicates that CT Technologist have good knowledge about CT exposure parameters.

The previous study by Mohamed M Abuzaid et al…, shows that CT clinical practice preceptors have average knowledge with only 72.2% of correct answer and showed low level of awareness of diagnostic reference levels [4]. The current study shows that CT Technologist have high level of knowledge with 83.74 % answered correctly and 16.26 % incorrect answer while Radiographers have low level of knowledge with 77.52 % answer correctly and 22.48 % incorrect answer.

The previous study by Mohammad Rawashdeh et al…, shows that 68.3 % correctly answered the questions regarding CT exposure parameters that show they have moderate knowledge [6]. The current study shows that 83.74 % CT Technologist and 77.52 % Radiographers have correctly answered the questions regarding knowledge of CT exposure parameters that show they all have overall good score. This finding is better than those presented in previous study.

In the previous study by Farshid Mahmoudi et al…, show that the total knowledge scores of Radiographers and CT Technologist were 36 ± 14 and 42.76 ± 12 respectively and the result was significantly statistically [21]. In current study the total knowledge of Radiographers and CT Technologist were 0.77 ± 0.417 and 0.83 ± 0.369 respectively and this result is also significant statistically.

In precious study by Mohamed M Abuzaid et al…, the participants ATCM knowledge were taken, 55 participants answered for question ATCM is affected by improper patient positioning 49 (89.1 %) answered correctly, for ATCM incorrect positioning decreased the patient dose on average 47 (85.5 %) answered correctly and for ATCM incorrect positioning increased the dose to obese patients 39 (70.9 %) answered correctly [4].For question 123 participants of CT Technologist and 123 Radiographers answered the questions, for ATCM is affected by improper patient positioning 120 (97.6 %) CT Technologist and 114 (92.7%) Radiographers answered correctly, for ATCM decreases patient dose 87 (70.7 %) CT Technologist and 83 (67.5 %) Radiographers answered correctly and for ATCM increases the dose to obese patients 95 (77.2 %) CT Technologist and 86 (69.9 %) Radiographers answered correctly.

In previous study Mohamed M Abuzaid et al…, the total knowledge findings of study were 72.2 % [4]. In Sundaran Kada study the total knowledge of Norwegian students were moderate i.e. 59.6% [35]. In Mohammad Rawashdeh et al…, study 68.3 % had better knowledge to the effects of the CT parameters related to image quality and radiation dose [6]. In current knowledge 83.74 % CT Technologist and 77.5% have total knowledge of CT exposure parameters which is good as compared to these studies.

The current study shows that the CT Technologist have good knowledge and well aware about CT exposure parameters but on the other hand Radiographers have less knowledge compare to CT Technologist about CT exposure parameters.

CHAPTER-7
CONCLUSION

CONCLUSION

The results of this study would be valuable to understanding the current level of knowledge and practice of CT exposure factors among the CT Technologist and radiographers which have a direct impact on patient radiation dose and image quality in CT procedures. This study revealed that the total knowledge CT exposure parameters of CT Technologist was good than the Radiographer. However, some areas of knowledge need improvement so there must be arranged of workshops and seminars and revise of academic content for both CT Technologist and Radiographers regarding CT exposure parameters on the CT department, so that they can practice the CT parameters more accurately and upgrade and update their knowledge, there should a specialized incharge in the department who should check the uses of parameters into the department on regular basis.

To create the awareness among the Radiological Staff about the consequential effect on patient dose safety seminars and classes was arranged but we have to do create more and more awareness about these effects for patient safety. So further study will be done with proper result.

CHAPTER-8
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CHAPTER-9
ANNEXURES

LETTER OF ETHICAL CLEARANCE FOR DISSERTATION

FROM REGISTRAR OFFICE

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

F. No. SU/R/2024/2132[2] Dated: 06.08.2024

Subject: Grant of Ethical Clearance for **Dissertation Protocol** Topic **"Assessment of Knowledge and Awareness of Radiological Staff regarding Computed Tomography Exposure Parameters in Delhi NCR Hospital and Diagnostic Center",** submitted by **DIVYA GUPTA,** student of M.Sc. Medical Imaging Technology, 2022 Batch.

*****

In supersession of this office letter No. SU/R/2024/1344[45] dated 17.05.2024 on the subject cited above, **DIVYA GUPTA** is informed that her request for grant of Ethical Clearance for the Dissertation Protocol entitled **"Assessment of Knowledge and Awareness of Radiological Staff regarding Computed Tomography Exposure Parameters in Delhi NCR Hospital and Diagnostic Center"**, was considered by the **Screening Committee** of the **Allied Health Sciences** in its meetings held on 07.02.2024 and 29.02.2024. The recommendations of the **Screening Committee** were considered in detail by the **Institutional Ethics Committee** in its meeting held on **15.05.2024** and the same was **approved** by the **Ethics Committee** of the **Santosh Deemed to be University, Ghaziabad, Delhi NCR**.

He /She is informed accordingly for further necessary action.

[Dr. EZHILRAJAN. K]
REGISTRAR

DIVYA GUPTA
M.Sc. Medical Imaging Technology.

Copy to:

1. The Vice Chancellor
2. The Dean – Academics
3. The Dean, SMC&H
4. The Dean – Research
5. The Director – IQAC
6. HOD/ Course In-charge of the concerned Department

PLAGIARISM CERTIFICATE

CT Parameter

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APPENDIX – I

QUESTIONNAIRE

Assessment of knowledge and awareness of Radiological Staff regarding computed tomography exposure parameters in Delhi NCR Hospitals and Diagnostic centre, India.

SECTION A (Demographic Information)

Name: …

Q1. Age

a. 20-30 years
b. 31-40 years
c. 41-50 years
d. 51- above

Q2. Gender

a. Female
b. Male

Q3. Qualification

a. Diploma
b. Bachelor's degree
c. Master degree
d. Other's

Q4. Occupation

a. Radiographer
b. CT Technologist

Q5. Work experience in CT

a. 0-3 Years
b. 4-6 years
c. 7-9 years

d. 10 above

Q6. CT Scan protocol decision is taken by

a. Technologist
b. Radiologist
c. Physicist
d. Application specialist

Q7. Confidence in altering protocol

a. Very confident
b. Moderately confident
c. Less confident
d. Not confident

Q8. Allow to modify any CT protocol to reduce patient dose

a. Yes
b. No

Q9. Attended any specialized CT training course

a. Yes
b. No

Q10. Work load in your work space

a. Sedentary
b. Moderate
c. Heavy
d. Extremely heavy

SECTION B (CT scan exposure parameters)

Q11. Reducing kVp would reduce the contrast resolution

a. Yes
b. No

Q12. kVp should increase with patients having metallic implants

a. Yes
b. No

Q13. Reducing kVp from 120 to 100 for angiographic procedure reduces the image contrast

a. Yes
b. No

Q14. Increasing kVp by 50% is equivalent to doubling the mAs

a. Yes
b. No

Q15. Doubling the mAs doubles the dose

a. Yes
b. No

Q16. Reducing the tube current by 50% increases the noise two-fold

a. Yes
b. No

Q17. mAs should be increased as the body part thickness increases

a. Yes
b. No

Q18. Decreasing the pitch degrades image quality

a. Yes
b. No

Q19. Increasing the pitch decrease the dose

a. Yes
b. No

Q20. A low pitch technique is helpful in detecting a small lesion

a. Yes
b. No

Q21. Can you reduce radiation dose in spiral CT by increasing pitch

a. Yes
b. No

Q22. Reducing the mAs reduces the noise

a. Yes
b. No

Q23. Increasing slice thickness increases noise

a. Yes
b. No

Q24. Readers can tolerate less noise with obese patients

a. Yes
b. No

Q25. A smoothing reconstruction kernel, increases the visualization of noise

a. Yes
b. No

Q26. Increase the slice thickness, decrease the patient dose

a. Yes
b. No

Q27. Decreasing the slice thickness will decrease the scan time

a. Yes
b. No

Q28. ATCM is affected by improper patient positioning

a. Yes
b. No

Q29. ATCM decreases patient dose

a. Yes
b. No

Q30. ATCM increases the dose to obese patients

a. Yes
b. No

Q31. ATCM increases the patient dose in the pelvic region

a. Yes
b. No

Q32. ATCM should not be used in the presence of metallic implants

a. Yes
b. No

Q33. Routine CT scanning parameters (kVp, mAs, slice thickness, pitch, etc.) should be changed according to patient size, anatomical region, Study indication, patient age

a. Yes
b. No

APPENDIX - II

MASTER CHART

Tasks	Tasks Duration	Start Date	End Date	June-July	Aug-Sep	Oct-Nov	Dec-Jan	Feb-Mar	Apr-May	Jun-July	Aug-Sep
Preparation of thesis proposal	21	15-07-2023	05-08-2023								
Presentation of thesis proposal	25	05-08-2023	30-08-2023								
Preparation & Submission thesis Application in Ethics Committee	41	30-08-2023	10-10-2023								
Review of Literature	89	10-10-2023	07-01-2024								
Data Collection	93	10-02-2024	13-05-2024								
Data Analysis	12	17-05-2024	29-05-2024								
Findings & Recommendation	8	31-05-2024	08-06-2024								
Report Writing	17	09-07-2024	17-08-2024								
Submission of thesis	5	28-08-2024	02-09-2024								
Presentation of thesis	0										